Report of the Naval Medical Research & Development Command and Office of Naval Research Technical Workshop on Combat Casualty Care

1976 Meeting

REPORT
OF THE
NAVAL MEDICAL RESEARCH AND DEVELOPMENT COMMAND
AND
OFFICE OF NAVAL RESEARCH
TECHNICAL WORKSHOP
ON

COMBAT CASUALTY CARE

Airlie House
Warrenton, Virginia

April 1976

Coordinated by

AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES

CONTENTS

SECTION I
TECHNICAL WORKSHOP PARTICIPANTS AND AGENDA

SECTION 2
TECHNICAL WORKSHOP PURPOSE

SECTION 3
THE PROGRAM PLAN

SECTION 4
WORKSHOP SUBCOMMITTEES

SECTION 5
WORKSHOP PROCEEDINGS

SECTION I

TECHNICAL WORKSHOP PARTICIPANTS AND AGENDA

PARTICIPANTS

Keynote Speaker

Vice Admiral Donald L. Custis, MC, USN
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Washington, D.C. 20390

Conference Chairman

Captain Clifford M.Herman, MC, USN
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Invited Guests

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Deputy Chief of Staff for Plans and Operations
Headquarters, U.S. Marine Corps
Washington, D.C. 20380

Rear Admiral C. L. Waite, MC, USN
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TECHNICAL WORKSHOP ON COMBAT CASUALTY CARE

AGENDA

Sunday, 25 April 1976

1800 - 2000	REGISTRATION Airlie House, Warrenton, Virginia
2000	RECEPTION no host

Monday, 26 April 1976

SESSION I: GENERAL SESSION

0800 - 0815	WELCOME AND INTRODUCTIONS Captain C. M. Herman, MC, USN Director, Clinical Investigation Programs Naval Health Sciences Education and Training Command Bethesda, Maryland
0815 - 0830	OPENING REMARKS Captain C. E. Brodine, MC, USN Commanding Officer Naval Medical Research and Development Command Bethesda, Maryland
0830 - 0900	GUEST SPEAKER Lieutenant General L. F. Snowden, USMC Deputy Chief of Staff for Plans and Operations Headquarters, U.S. Marine Corps Washington, D.C.

0900 - 0945	KEYNOTE ADDRESS Vice Admiral D. L. Custis, MC, USN Chief, Bureau of Medicine and Surgery Department of the Navy Washington, D.C.
0945 - 1015	GUEST SPEAKER Rear Admiral B. Eiseman, MC, USNR Professor of Surgery University of Colorado Medical Center Denver, Colorado
1015 - 1030	BREAK
1030 - 1045	STATUS REPORT 1: PRIMARY CASUALTY CARE Captain R. W. Jones, MC, USN Director, Surface Medicine Division Bureau of Medicine and Surgery Washington, D.C.
1045 - 1100	STATUS REPORT 2: FIELD CASUALTY EVACUATION AND HOSPITAL CARE Captain A. C. Wilson, MC, USN Commanding Officer Naval Regional Medical Center Great Lakes, Illinois
1100 - 1115	STATUS REPORT 3: SHIPBOARD CASUALTY EVACUATION AND CARE Captain J. W. Johnson, MC, USN Force Medical Officer Command Naval Surface Force Pacific San Diego, California
1115 - 1130	STATUS REPORT 4: STRATEGIC EVACUATION AND INFLIGHT CASUALTY CARE Colonel R. W. Poel, MC, USAF Chief, Medical Plans and Health Programs Division U.S. Air Force Office of the Surgeon General Washington, D.C.
1130 - 1145	STATUS REPORT 5: DEFINITIVE CASUALTY CARE Captain J. Cox, MC, USN Chief of Orthopedics Naval Hospital Annapolis, Maryland

1145 - 1200	STATUS REPORT 6: CASUALTY CARE DATA SYSTEM Colonel M. W. Hannegan, MC, USA Director, U.S. Army Tri-Service Medical Information Systems Agency Walter Reed Army Medical Center Washington, D.C.
1200	LUNCH
1330 - 1400	CHARGE TO WORKSHOP: THE TECHNICAL WORKING GROUP AND ITS ROLE IN FUTURE MEDICAL RESEARCH AND DEVELOPMENT A. B. Callahan, Ph.D. Biological and Medical Sciences Division Office of Naval Research Arlington, Virginia

SESSION II: GROUP SESSION

1400	SUBCOMMITTEE MEETINGS assigned rooms
1800	DINNER

SESSION III: GROUP SESSION

1930	SUBCOMMITTEE MEETINGS assigned rooms
	EXECUTIVE SESSION Subcommittee Chairmen

Tuesday, 27 April 1976

SESSION IV: GROUP SESSION

0830 - 1200	SUBCOMMITTEE MEETINGS assigned rooms

1200	LUNCH
	SESSION V: GENERAL SESSION
1330 - 1345	SUBCOMMITTEE ON PRIMARY CASUALTY CARE Preliminary report and discussion
1345 - 1400	SUBCOMMITTEE ON FIELD CASUALTY EVACUATION AND HOSPITAL CARE Preliminary report and discussion
1400 - 1415	SUBCOMMITTEE ON SHIPBOARD CASUALTY EVACUATION AND CARE Preliminary report and discussion
1415 - 1430	SUBCOMMITTEE ON STRATEGIC EVACUATION AND INFLIGHT CASUALTY CARE Preliminary report and discussion
1430 - 1445	SUBCOMMITTEE ON DEFINITIVE CASUALTY CARE Preliminary report and discussion
1445 - 1500	SUBCOMMITTEE ON MEDICAL CARE DATA SYSTEMS Preliminary report and discussion
	SESSION VI: GROUP SESSION
1500 - 1700	SUBCOMMITTEE MEETINGS assigned rooms
1700 - 1800	SOCIAL HOUR no host
1800	BANQUET Role of the Military in Emergency Medical Care Captain C. M. Herman, MC, USN
	SESSION VII: GROUP SESSION
1930 - 2200	SUBCOMMITTEE MEETINGS assigned rooms

Wednesday, 28 April 1976

SESSION VIII: GROUP SESSION

0830 - 1000	SUBCOMMITTEE MEETINGS assigned workshop rooms
1000 - 1015	BREAK

SESSION IX: GENERAL SESSION

1015 - 1045	SUBCOMMITTEE ON PRIMARY CASUALTY CARE Final report and discussion
1045 - 1115	SUBCOMMITTEE ON FIELD CASUALTY EVACUATION AND HOSPITAL CARE Final report and discussion
1115 - 1140	SUBCOMMITTEE ON SHIPBOARD CASUALTY EVACUATION AND CARE Final report and discussion
1140 - 1200	SUBCOMMITTEE ON STRATEGIC EVACUATION AND INFLIGHT CASUALTY CARE Final report and discussion
1200 - 1330	LUNCH

SESSION X: GENERAL SESSION

1330 - 1400	SUBCOMMITTEE ON DEFINITIVE CASUALTY CARE Final report and discussion
1400 - 1430	SUBCOMMITTEE ON MEDICAL CARE DATA SYSTEM Final report and discussion
1430 - 1500	COMMITTEE OF THE WHOLE Discussion: Future R&D Efforts in the Area of Casualty Care Research
1500 - 1530	SUMMARY REMARKS Conference Chairman

SECTION 2

TECHNICAL WORKSHOP PURPOSE

TECHNICAL WORKSHOP PURPOSE

Introduction

Management of combat casualties is the sine qua non of military medicine and was the basis for establishing the Navy medical department. Providing quality treatment to the seriously injured under the adverse conditions of combat is fraught with numerous problems, demanding the highest quality of medical care and the most advanced medical technology. Although the state of the art in casualty care has advanced significantly over the years, there are still numerous problems that can only be resolved through biomedical research and development programs.

It is the mission of the Naval Medical Research and Development Command to manage all medical department research, development, test and evaluation programs concerning the health, safety and performance of naval personnel. The development of new and improved methods and procedures for the treatment and management of combat casualties is a vital element of this mission.

Purpose of the NMRDC - ONR Workshop

The primary mission of the Navy Medical Department is basically to conserve military manpower. This medical mission can be divided into four major functions, all interrelated. They are physical standards, preventive medicine, medical management of patients and maintenance support of health care functions.

The purpose of this technical workshop is to establish a set of relevant medical research and development goals that relate specifically to the medical management of combat casualties.

To accomplish this task, clinicians and biomedical research workers from the military services and the civilian community have been brought together to identify, study and analyze current as well as projected operational medical requirements and problem areas. The workshop will be specifically tasked to:

1. Identify specific problem areas.
2. Determine whether identified problems are appropriately documented.
3. Establish priorities within identified problem areas.
4. Recommend feasible biomedical research and development approach.

Since the time allotted to the workshop is limited, only the problems of the medical management of trauma patients will be addressed. Medical management of trauma patients in the context of this workshop involves two basic measures, patient evacuation and patient treatment.

Need For and Current Status of Casualty Care Research Program Within the Department of Defense

The effects of enemy weapons are the second most common cause of incapacitation and the first cause of death in war. Surgical research has markedly reduced the mortality rates in battle. For every 100 men injured by enemy action, 27 died in WW II and 17 in Vietnam. For those men admitted to hospitals for wounds, 4% died in WW II and 2% in Vietnam.

Care of the wounded casualty under combat conditions requires a system of echeloned treatment, since complete hospital facilities cannot be at the scene of battle action. The major components of the system are medical evacuation, forward mobile surgical facilities, mobile combat support hospitals and fixed or semi-fixed general hospitals. Means for emergency treatment and early resuscitative surgical care must be in the battle area to resuscitate the seriously injured prior to their trip to a hospital. These components are all interdependent and are a continuous chain of evacuation and treatment that extends from the point where a man is injured to the point where he has completed his convalescence - or died. All elements of this system constitute an entity having common problems, common equipment and common modes of operation; hence, they are approached with a common perspective in research and development activities. Because battle often produces massed casualties and because the patient moves and the surgeons don't, standardization of diagnostic and surgical procedures, methods for rapid physiological stabilization and movement, prevention of shock and wound infection, selective treatment necessitated by variation in wounding agents and provision of evacuation equipment are the major features of this kind of surgical care that differ from civilian surgical care. Each of these requirements is addressed in the research program. Evacuation methods, improvement in field hospital facilities, studies of physical rehabilitation and prosthetic devices, and bioengineering are as much a part of this system complex as is the more obvious work on shock, burns, blood replacement, wound sepsis and surgical techniques.

The core of this program is directed toward the prevention and treatment of trauma, that is, injury caused by physical insult. Although the organizing theme - especially in war time - is the battle casualty, trauma from accidents or weapons systems failures, e.g., aircraft crashes, provides an appreciable number of casualties in war and a source of patients and clinical research material in peace. At the center is the research directed at the patient's

immediate resuscitation and treatment - studies on blood and plasma volume expanders, on reparative surgery and transplantation, on burns and on oral and maxillofacial and nervous system injury.

When the patient leaves the operating room, his problems are related to his ability to mend and to ward off complications of infection, sepsis, hemorrhage and wound breakdown. The research here is devoted to studies of wound healing, stress ulcer, surgical nutrition and tissue metabolism.

Sustaining and supporting the direct patient care investigations are the programs for developing field medical facilities and equipment and the systems and equipment for medical evacuation.

Taken as a whole, the ultimate goal of traumatic casualty research and development is to ensure that no injured patient who survives to reach a medical facility should die from his injury.

SECTION 3

THE PROGRAM PLAN

THE PROGRAM PLAN

Purpose of the Program Plan

This program plan is intended to present the procedures, information and techniques expected to help the Technical Workshop achieve its purpose, and to suggest certain problems in the scientific areas to be discussed.

Method of Operation

All conferees should read this program plan, which identifies certain problem areas, and become familiar with its contents. It is essential that each participant be thoroughly familiar with the material to be covered prior to the meeting. The time available is limited; therefore, a very tight schedule has been established. The schedule provides approximately 16 hours or 960 minutes for subcommittee meetings. Eight hundred of these minutes will be devoted to problem consideration and research avenues for solution of problems. The remaining minutes will be devoted to preparation of the subcommittee reports. It is, therefore, essential that each participant come to the Workshop with well thought out ideas relative to the problem areas to be considered by his specific subcommittee. The success of the Workshop will be directly related to the thoroughness with which each participant does his homework.

As a guide to the thought process involved in pre-workshop preparation for the subcommittee session, it is suggested that each subcommittee member:

Address the general problem area in light of his past and current clinical and research experience

Attempt to define the specific problem(s)

Determine the goals to be achieved

Identify research avenues that might be recommended to achieve the goal, e.g., basic science knowledge needed, the development of an animal model and clinical investigation studies

Consider the impact of achievement of the goals on casualty treatment and care, the scope of applicability, and the cost benefits to be accrued.

The problems to be addressed by the Workshop have been divided into six broad areas. A subcommittee is established for each area, from the membership of the Workshop. Each Workshop member is a member of one subcommittee. The assignments as indicated in Section 4 of this Program Plan are based (to the maximum extent possible) on individual interest and ability to contribute. On the same basis, the general chairman has assigned a chairman for each subcommitte. The subcommittee chairmen should each be assisted by an appointed recorder.

Conferees will function as a collection of experts in various facets of Combat Casualty Care but not as official representatives of the activities to which they are attached. This approach is necessary to ensure that the group's deliberations can focus on the basic problems involved in providing optimum treatment to combat casualties under various operational scenarios.

The deliberations of each subcommittee will involve four phases:

Definition of problem areas as determined by the subcommittee

Discussion of the problems presented leading to identification of avenues of research to solve the problem

Formulation of subcommittee recommendations

Preparation of a subcommittee report.

Session V (presentation of preliminary reports) is scheduled after the two initial subcommittee sessions and is intended to provide an opportunity for each subcommittee to present a brief overview of the material it is covering and its accomplishments at that point.

Final reports of each subcommittee will be presented during Session VII. Each final report should be prepared as a self-sufficient document because it may be reproduced and circulated. If minority reports are filed, they will be published as an appendix to the majority report, and the abstract will encompass both reports. The subcommittee will not be required to prepare report front matter; this will be accomplished by the technical support contractor in consultation with the Technical Workshop Planning Committee. Secretarial support for these working sessions will be provided.

On the last day of the meeting, the Workshop will convene as a committee-of-the-whole to coordinate and combine the various group reports into a Workshop report. Subcommittee chairmen will cause their respective reports to be modified as required to include the input gained from the committee-of-the-whole. Subcommittee chairmen will then submit their final reports to the Workshop chairman.

The final Workshop report is intended to:

Identify problem areas from a medical standpoint that are factors in the achievement of optimum casualty care

Determine whether identified problems are appropriately documented

Establish priorities within identified problem areas

Recommend feasible biomedical research and development approaches.

The final Workshop report will be published after conclusion of the Workshop.

SECTION 4

WORKSHOP SUBCOMMITTEES

WORKSHOP SUBCOMMITTEES

Instructions to Chairmen

As Chairman of a subcommittee you are to guide the discussions in relation to the assigned tasks. The "general charge" for each subcommittee defines the area in which specific comments and recommendations of the participants are to be obtained. A series of questions or topics are posed that may serve as a starting point for subcommittee deliberations. Additional items should be added and the listed questions or topics modified to meet the needs of the problem at hand.

You must provide leadership to the subcommittee so that ample opportunity is given to each member to contribute to the discussion. You must not let the discussion be dominated by any one person and yet must fully use the experiences of each member of the subcommittee to solve problems.

Each subcommittee chairman will appoint a Recorder from the membership of the subcommittee to keep a written record of the discussion. A report will be prepared by the Recorder for presentation to the entire Working Group for consideration, modification and acceptance. As Chairman, you will present the report of your subcommittee.

Instructions to Recorders

Recorders of each subcommittee should keep a record of all discussions relevant to the general charge of the subcommittee. Specific answers to the questions and recommendations including minority reports should be written in a form that may be read before the entire Workshop by the Chairman.

At the time of the presentation of the report and resultant discussion, Workshop (committee-of-the-whole) action on the report should also be recorded.

Upon completion of modification of the report to make it acceptable to the total Workshop, the final written report of the subcommittee (as modified) shall be presented to the Chairman of the Workshop for publication in the proceedings.

Instructions to Individual Participants

This Workshop has three components: first to review current programs

and objectives of combat casualty management and determine their effectiveness; second, to serve, in workshop fashion, as a panel of experts to identify current problems and areas in need of research and development; and third, to make recommendations for research to meet the future needs of the Navy with available techniques as well as with projected new techniques.

A great deal has to be accomplished in a short time, and therefore, a full schedule has been planned, which, if followed, will make it possible to complete the task in the three days available.

Each individual should seek out information regarding the problem areas and be prepared to discuss them during the subcommittee sessions. The strength of the subcommittees will be in the contributions made by the participants. The chairman of each subcommittee will guide the discussion in relation to the assigned task, but will be seeking specific comments and recommendations from the participants that can be included in a Workshop report. Care should be taken to avoid random discussions that cannot materialize in a serious recommendation. However, each participant should feel free to introduce new material pertinent to the assigned task.

Your assistance is very much appreciated.

Subcommittee Assignments

The following subcommittees are established:

Subcommittee	General Area of Interest
1	Primary Casualty Care
2	Field Casualty Evacuation and Hospital Care
3	Shipboard Casualty Evacuation and Care
4	Strategic Evacuation and Inflight Casualty Care
5	Definitive Casualty Care
6	Casualty Care Data System

The following pages present individual subcommittee assignments, a general charge to the subcommittees, and items for their consideration. Pages of this document and report forms related to a subcommittee have been provided for quick reference.

SUBCOMMITTEE 1

Subcommittee on Primary Casualty Care

Chairman: Captain R. W. Jones, MC, USN

Members:

CAPT D. R. Hauler, MC, USN
CDR C. A. Roper, MSC, USN
COL W. L. Scheetz, MC, USA
CDR R. W. Virgillio, MC, USN
CAPT C. M. Herman, MC, USN
ENS E. Wyatt, MSC, USN
HMCM F. Monk, USN
G. S. Moss, M.D.
R. Thorner, Ph.D.

General Charge: To identify, analyze and document those problems which play a major role in early casualty care. Emphasis should be directed at treatment and care at the first medical echelon, the field corpsman. Special attention should be paid to such considerations as the extent of treatment that can be provided under a variety of combat scenarios, the quality and quantity of medical equipment and facilities available, capability of personnel and type and extent of injuries expected. Specific deficiencies should be identified and research and development pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concerns and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's considerations of areas which require attention of the Naval Medical Research and Development Command.

1. Optimal resuscitative fluid for use in field, crystalloid vs. colloid solutions.

2. Special equipment improvements which can be suggested to assist the corpsman in performance of his function, e.g., inflatable splints, tourniquets.

3. Special requirements for corpsman operating in extreme cold or heat, mud and dust.

4. Additional treatment procedures which could be handled by corpsman.

5. Criteria for quantities of resuscitative fluids to be administered.

6. Criteria for type and quantities of medications to be administered.

7. Special problems in the transfer of documentation of first echelon casualty care treatment of patient to next echelon of medical care.

SUBCOMMITTEE 2

Subcommittee on Field Casualty Evacuation and Hospital Care

Chairman: Captain A. C. Wilson, MC, USN

Members:

LCDR J. F. Bates, MSC, USN	LCOL S. Sande, MSC, USA
CAPT L. W. Gay, MSC, USN	CAPT B. K. Slemmons, MC, USN
CDR G. Harris, MSC, USN	CAPT C. R. Valeri, MC, USN
CAPT R. M. O'Brien, MC, USN	LCOL W. H. Wilson, MC, USA

General Charge: To identify, analyze and document those problems involved in field casualty evacuation and hospital care. Consideration of the subcommittee in this area should be directed at the development of medical procedures and technology which will reduce the elapsed time between injury and definitive medical care and provide optimal therapy at the second echelon of medical care, the field hospital. Specific deficiencies should be identified and research pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concern and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's consideration of areas which require attention of the Naval Medical Research and Development Command.

1. New or improved life support systems which should be available for this phase of casualty management, e.g., ventilators, respirators.

2. Effects of transport mode on casualty treatment.

3. Additional anticipatory treatment which might be provided.

4. Special multipurpose equipment to mitigate effects of ground transportation, e.g., thermal insulation, slam protection, flotation.

5. Additional treatment to be provided in relation to patient holding time and type of wound.

6. Field ruggedized diagnostic and treatment equipment.

7. Contingency field hospital facilities requirements in event of delayed casualty evacuation.

8. Treatment of cold injury and cold injury superimposed on trauma.

SUBCOMMITTEE 3

Subcommittee on Shipboard Casualty Evacuation and Care

Chairman: Captain J. W. Johnson, MC, USN

Members:

CAPT F. H. Austin, Jr., MC, USN	CDR L. Mantel, MC, USN
CAPT S. Bellinger, MC, USN	CAPT M. Mills, MC, USN
CAPT R. C. Cochran, MC, USN	CAPT B. M. Shepard, MC, USN
CDR J. W. Liming, MSC, USN	HMCM R. C. Smith USN

General Charge: To identify analyze and document those problems involved in shipboard evacuation and care of casualties. Specific attention should be paid to the development of medical procedures and technology which will improve the efficiency of casualty handling and treatment procedures which are unique to restricted shipboard environments. Specific deficiencies should be identified and research pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concern and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's consideration of areas which require attention of the Naval Medical Research and Development Command.

1. Special requirements in intensive care beyond what is currently available.

2. Techniques to simplify the delivery of complex modern medical technology.

3. Requirements for special items of portable treatment or diagnostic equipment for particular medical specialties, e.g., ENT, neurosurgery, chest surgery, etc.

4. Requirements for blood components facility.

5. Improved resuscitative fluids, fluorocarbons, artificial hemoglobin, etc.

6. Requirements for redesign of current medical equipment for increased compatibility with shipboard environment.

SUBCOMMITTEE 4

Subcommittee on Strategic Evacuation and Inflight Casualty Care

Chairman: Colonel R. W. Poel, MC, USAF

Members:

CDR W. H. Benedict, MSC, USN	CDR D. R. Stoop, MC, USN
COL K. Curtis, MC, USAF	MAJ R. B. Weiskopf, MC, USA
CDR J. A. Nelson, MSC, USN	L. A. Kiesow, M.D., Ph.D.
CDR L. W. Raymond, MC, USN	H. Proctor, M.D.

General Charge: To identify, analyze and document those problems involved in strategic evacuation and inflight casualty care. This echelon of casualty management is the primary responsibility of the U.S. Air Force. Therefore, the consideration of the subcommittee should be directed at a review of current technology in this area, with a goal of determining problems in the compatibility of medical procedures and equipment in the echelons preceding and following strategic evacuations and inflight casualty care. Specific deficiencies should be identified and research and development pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concerns and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's consideration of areas which require attention of the Naval Medical Research and Development Command.

1. Establish/standardize criteria for patient stability and evacuation.

2. Consideration of treatment modalities to better prepare casualty for strategic evacuation.

3. Requirements for life support equipment which is compatible across various medical echelons.

4. Requirements for fluid replacement, wound cover, and other therapeutic measures to be compatible with evacuation.

SUBCOMMITTEE 5

Subcommittee on Definitive Casualty Care

Chairman: Captain J. Cox, MC, USN

Members:

COL C. R. Bauer, MC, USAF
CAPT C. B. Early, MC, USN
CDR C. Cloutier, MC, USN
CDR J. R. Fletcher, MC, USN
CAPT W. J. Fouty, MC, USN
CAPT J. F. Kelly, DC, USN
COL B. A Pruitt, MC, USA
CAPT K. W. Sell, MC, USN

General Charge: To identify, analyze and document those problems involved in the delivery of definitive casualty care. Special attention of the subcommittee should be directed to identification of research and development efforts which will reduce the time and cost required for definitive hospital care and rehabilitation and facilitate return to active duty. Specific deficiencies should be identified and research and development pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concerns and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's considerations of areas which require attention of the Naval Medical Research and Development Command.

1. Techniques for treatment of radiation injury.

2. Neurosurgical research requirements: nerve transplantation, nerve regeneration.

3. Orthopedic research requirements: accelerated bone healing, bone transplantation.

4. Requirements for tissue preservation research, and improved techniques in reconstructive surgery.

5. Requirements for research in post-injury sepsis.

6. Methods for assessment of influence of earlier treatment on definitive care procedures.

SUBCOMMITTEE 6

Subcommittee on Casualty Care Data System

Chairman: Colonel M. W. Hannegan, MC, USA

Members:

CAPT P. A. Flynn, MC, USN
LT V. Gordon, MSC, USN
LCDR J. R. Knight, MSC, USN
MAJ R. S. Strachan, MSC, USA
J. J. Bircher, Ph.D.
B. Eiseman, M.D.
A. W. Forrey, Ph.D.
J. G. Garrick, M.D.
L. P. Hellman Ph.D.
L. Homer, M.D., Ph.D.

General Charge: To identify, analyze and document those problems involved in the maintenance and use of patient records. Subcommittee should address their considerations to problems in the transfer of medical treatment data across medical echelons and consider possibilities for data management systems which would be useful in the review and evaluation of treatment modalities employed at various medical echelons. Specific deficiencies should be identified and research and development pathways recommended which will correct the identified problem.

The following topics are presented to be illustrative of topical concerns and to initiate discussion. They should not be interpreted as limiting the scope of the subcommittee's considerations of areas which require attention of the Naval Medical Research and Development Command.

1. Improved techniques for patient identification.

2. Standardized treatment coding system.

3. Standardized injury or disease coding system.

4. Continuity of medical records across medical echelons.

5. Solution to problems of lost medical records.

6. Interface of patient records to patient record data systems.

7. Capture of medical treatment data at various echelons.

8. Feedback and analysis of treatment data both ways in the patient transport plan.

SECTION 5

WORKSHOP PROCEEDINGS

OPENING REMARKS

Captain C. E. Brodine, MC, USN

I would first like to express appreciation for the outstanding response received from all of you at our request for participation in this workshop. I feel that this is a reflection of the importance and the interest given to the subject of combat casualty care at the highest levels of the Naval Medical Department and Marine Corps.

Important it is, indeed. I do not think I have to tell this audience of the importance of the contributions that have come from research related to combat casualty care sponsored by the Army, Navy, and Air Force in the past, or of the impact that those accomplishments have had in reducing mortality and morbidity figures, particularly as they related to the recent conflict in Vietnam.

I do not think that I have to remind anyone in the audience of what has happened to research support in the past during interbellum periods. With the cessation of hostilities, the urgency of developing solutions to casualty care problems seems to wane and we experience a reduction in interest and funding support.

We pay a price for this in several ways. Some of the problems are of such complexity that a sustained effort is required in order to come up with appropriate information and answers. Also lost sight of, is the need for an in-house cadre of experts in all services who can serve in a consultative capacity during peacetime and who have a quick response capability in the event of renewed conflict.

During its meetings last summer, the Defense Science Review Board put combat casualty care high on its list of areas of concern. The technical working group that is assembled here today is a consequence of the recommendations of that Board, as well as those of DDR&E, to assess thoroughly the requirements for RDT&E in the area of combat casualty care and to be sure that we respond to those requirements as we move into the future.

It might be helpful for me to take just one or two minutes to give you a brief overview of the Naval Medical Research and Development Command structure

and our research programs. The Command is an echelon-three field activity located at the National Naval Medical Center. Our mission, briefly stated, is to manage the research, development, test and evaluation programs of the Medical Department which relate to the health, safety, and performance of naval personnel. These programs are conducted at seven laboratories within the continental United States, and four laboratories overseas, located in Taiwan, Indonesia, Ethiopia, and Egypt. In addition, we sponsor work at other non-medical research laboratories within DOD, and have a contract research program which is coordinated through the Office of Naval Research. I would like to emphasize at this point that this workshop is jointly sponsored by the Naval Medical Research and Development Command and the Office of Naval Research.

As far as our programs are concerned, we have major programs in diving and submarine medicine, aviation medicine, human performance as it relates to the various operational platforms, and infectious diseases, with particular emphasis on tropical diseases that pose threats to forces in the field. The dental research program is a very productive program, placing emphasis on repair of maxillofacial injuries as well as the prevention of dental disease. The occupational health program stresses the problems of thermal stress, toxicology, and electromagnetic radiation. The combat casualty care program is an essential part and vital element of the fleet health care research program.

These programs undergo continual review, both internally within the Command and externally through various committees and organizations, most recently by the House Appropriations Committee. It is important for us to be assured that the limited resources that we have are dedicated to problems and requirements that are relevant and of high priority. The key to this, obviously, lies in the periodic definition and revalidation of RDT&E requirements. It is for this purpose that we convene technical workshops, which bring members of the user and research communities together in the interest of mutually redefining and assessing problem priorities.

You can see by the nature of the agenda that we will cover a number of subject areas that are not unique to Navy and Marine Corps medical problems. They extend across all three military services; hence, the triservice participation in this workshop. Obviously, the output should be of value to the research programs of all three services.

We have an outstanding environment to conduct this workshop, and the last ingredient to ensure that this workshop will be a success are the individuals in this room. I am looking forward to a stimulating and productive session.

MEDICAL SUPPORT FOR MARINE CORPS OPERATION

Lieutenant General L. F. Snowden, USMC

I am delighted and honored to be afforded the opportunity to address such a prestigious group of physicians and medical service personnel.

Usually when one is invited to be a guest speaker, he is expected to be informative and entertaining. Unfortunately, our present capabilities to support Marine Corps requirements, from a medical point of view, do not lend themselves to much mirth. Illustrative of this fact are the recent comments of CINCLANTFLT and CINCPACFLT made in response to a questionnaire recently circulated by the Navy Health Care Review Committee, an OPNAV proposed study, which just concluded in January of this year.

In response to the question, "Are there sufficient health care facilities available within the amphibious task force to support the landing of a marine amphibious unit, a marine amphibious brigade, or a marine amphibious force?" CINCLANTFLT stated, "There are sufficient health care facilities organic to the typical amphibious task force to support the landing of a MAU. There would be no redundancy, and in some areas the facilities would be stressed, but it could be made to work. The medical and dental facilities of the amphibious task force could not support the landing of a marine amphibious brigade nor a marine amphibious force."

CINCPACFLT, responding to the same questions, stated, "Assuming the landing is opposed and casualties will be received, the answer must be no, due to the non-availability of fully qualified casualty receiving ships."

I do not have to tell you with what grave concern we in the Marine Corps view these comments. Today we find ourselves confronted with ever-increasing contingency requirements, and an inadequacy of amphibious shipping capabilities. This is being further eroded by the requirement to leave major combatant vessels in the objective area in order to ensure a marginal-at best-level of medical support for our forces.

It was for these foregoing reasons that I welcomed the opportunity to come here and address you.

In extending his invitation, Captain Brodine stated that he thought it would be helpful to give you a brief unclassified overview of the various combat scenarios for future Marine Corps operations with an estimate of the number and type of casualties anticipated. As will readily become apparent, this was no small project.

In order to develop this thought into a meaningful base for your further discussions during the coming week, I shall explain how marine forces are task organized, review briefly the concepts for supporting these forces, and conclude with a general overview of when and how these forces would be committed to combat operations, with a rough estimate of the combat casualties anticipated.

Generally, when we speak of marine forces, we refer to them as a marine air-ground task force or MAGTF. A MAGTF is a task organization tailored to accomplish the specific mission or missions assigned. This task organization is designed to exploit the combat power inherent in closely integrated air and ground operations. The composition of a MAGTF may vary considerably, but will normally include the following major components:

- a command element
- a ground combat element
- an aviation combat element
- and, a combat service support element.

There are three types of MAGTF's which can be task organized from the resources provided by the fleet marine forces. These units are:

- a marine amphibious unit or MAU
- a marine amphibious brigade or MAB
- or, a marine amphibious force or MAF.

The MAU is the smallest MAGTF organization, and is normally built around a battalion landing team and a composite aviation squadron with a total strength of approximately 1800 to 2000 men. The MAU is considered to be the forward afloat deployed element of a larger landing force such as a MAB, which would be constituted as required from CONUS and/or forward based combat-ready fleet marine forces.

Currently, we maintain two MAU's afloat at all times. One in the Western Pacific and the other in the Mediterranean, as the Landing Force, 6th Fleet.

Due to their size and limited combat capabilities, these MAU's are intended to provide a U.S. presence and to convey a U.S. resolve to commit forces, if required, to support our national objectives. Normally, these forces are only committed in a low-threat environment and to limited operations such as the evacuation of non-combatant American citizens from troubled areas, as was done on Cyprus in 1974. However, if the situation

so dictated, a MAU could be committed to combat operations such as securing a forward airhead for the rapid air deployment of a MAB size follow-on force.

As is apparent from this wide range of missions, the projection of a meaningful MAU casualty rate is impossible.

Although the missions assigned are extensive, MAU operations are fairly limited in scope. Consequently, their medical and logistical support normally remains afloat with the seaborne mobile logistical support base. Under this concept, only emergency first aid type treatment is provided ashore with all hospital services being provided aboard the ships of the amphibious task unit.

The second largest MAGTF is the marine amphibious brigade. A MAB is normally build around a regimental landing team and an aviation combat group with a combined strength of approximately 4800 men. The MAB is normally commanded by a brigadier general and is capable of conducting air-ground amphibious assault operations in low and mid-intensity conflicts. During potential crisis situations, the MAB may be forward deployed afloat for an extended period in order to provide an immediate response capability and to strengthen the perception of the U.S. resolve, unencumbered by foreign-base or over-flight rights. If it becomes necessary to commit the MAB, combat operations may be supported, including medical support, from either the seabase, or from facilities ashore, or from a combination of both. Although more formidable than a MAU, the MAB is normally organized to accomplish a mission of limited scope.

Combat scenarios which require a MAB size force generally fall into two categories. The first example envisions an amphibious assault followed by subsequent operations ashore. Under this concept, the MAB would be subjected to the higher casualty rates normally associated with an amphibious assault during the first day or two of operations, after which time the rate should stabilize. An example of this type of operation would be the landing of marine forces in Lebanon to establish a safe zone for the collection and evacuation of American citizens and the subsequent withdrawal of the force.

The second type of MAB operations does not include an amphibious assault. Under this concept, marine forces are either positioned prior to the actual outbreak of hostilities, or else enter the combat zone through secure ports or airfields. Examples of this type of operations include:

- The deployment of a MAB to assist in the defense of the air and sea approaches to the Panama Canal.
- The reinforcement of the special mission forces committed to the defense of the Guantanamo Naval Base.

- The commitment of a MAB to secure our bases in the Azores.

Under these scenarios, the MAB is not subjected to the higher amphibious assault casualty rates. However, without the amphibious task force to provide medical and logistical support, the force is encumbered with the total support requirements which may have an adverse impact on the quality and level of medical care available.

The largest MAGTF is the marine amphibious force. The MAF may be formed with many variations in task organization structure, ranging in size from one division/wing team up to several divisions and aircraft wings together with an appropriate combat service support organization. Normally, a one division/one aircraft wing MAF consists of approximately 42,000 men and is commanded by a major general. The MAF is capable of conducting a wide range of amphibious assault operations and sustained combat operations ashore. Because of its size and combat power, the logistical and medical support for a MAF is always located ashore. However, during the amphibious assault phase, logistical and medical support is provided from the ships of the amphibious task force. As is apparent from their size and tremendous combat power, we normally think of committing MAF size forces in situations which would be termed mid or high intensity conflicts. Some examples of situations requiring one or more MAF's would be:

- As the strategic reserve for SACEUR during a NATO-Warsaw Pact conflict in Europe. In this role, the MAF or MAF's could be employed for amphibious assault operations to either the northern or southern flanks of NATO, or both, in order to relieve the pressure on the central front. Additionally, if required, these forces could be used as conventional ground forces to reinforce the central front itself.
- A MAF size force could also be required to assist in countering or preempting a Soviet military move into the Middle East in order to preserve access to Persian Gulf oil and retain U.S. influence and freedom of action in the area. For example, a MAF could be required to reinforce and support Iran against a Soviet backed Syrian invasion of Iran or Kuwait.
- In the Pacific, a MAF could be required to support the Republic of Korea against North Korean aggression, or to restrict the Soviets' use of strategic sea lanes of communication.

From the foregoing overview, it is apparent that the size and scope of scenarios requiring the commitment of marine forces is almost limitless, requiring a wide range of medical support capabilities. To assist you in your various work groups, I have brought along some unclassified casualty rate tables for your use in determining casualty numbers for a specific size force in a given scenario.

Earlier, I alluded to the Marine Corps' grave concern for our medical

support capabilities. I have just briefly reviewed, in general terms, how marine forces are tasked, organized, and when and how these forces would be committed. Now if I may, I would like to become a little more specific in order to focus clearly on the magnitude of the problem at hand. Let us assume that we are required to commit a one division/one aircraft wing MAF to a mid-intensity amphibious assault on the southern flank of NATO. We shall assume that the amphibious assault phase will require two days, and that the amphibious task force will remain in direct support of the MAF for a total of five days. During the initial two days, we would anticipate approximately 325 casualties, after which time our rate would stabilize at approximately 90 casualties per day. With the amphibious task force in direct support, we shall assume that the first five days of casualties, approximately 596 patients, will be treated aboard ship.

While these combat operations are on-going, we would be unloading our five medical companies of the force service support group in order to provide medical support ashore. Each medical company carries with it, organically, a 60-man hospital capability, so that at the end of five days, we would have established a 300-bed total capability ashore. In addition to the medical companies, we also have one hospital company, with a 200-bed capability, in the force service support group. This organization is designated to arrive with the assault follow-on echelon of amphibious shipping and should arrive in the objective area by D+5 and be established ashore by D+10, giving us a total capacity of 500 beds. Here I must remind you that when I say "beds", I mean cots in a tent which, from an environmental or climatic point of view for the treatment of trauma patients, is no improvement over the medical facilities used in the Civil War.

During this time, combat operations are continuing with air support being provided from airfields outside of the amphibious objective area and from the carrier task forces at sea. If all goes well, we shall be able to capture and rebuild an enemy airfield or establish an expeditionary airfield ashore by D+15.

While all of this has been going on, we have been sustaining our daily casualty rate of approximately 90 men per day, this means, in simple terms, that by the time we are able to commence medical evacuations from the battle area, we already have 400 patients more than we can support. If we apply the Department of Defense planning guidance of a 60-day evacuation policy, we shall have somewhere in the neighborhood of 1500 casualties lying around waiting for treatment. From a statistical point of view, this level of medical support is totally unacceptable.

From the foregoing, it is apparent that much has to be done to improve our medical support capabilities, and that you, as research and development personnel, are afforded a tremendous opportunity to contribute to

that solution. By this, I do not mean to say or imply that no one else is working on these problems, for they are. The delivery of the five LHA's will increase the amphibious task force commander's capability to provide up-to-date medical treatment facilities for the landing force. However, as previously noted, our fleet commanders are hesitant to leave major combatant vessels in the objective area solely to provide medical support. I should note that for the time that the LHA's are available, they provide us with two main operating rooms augmented by two emergency operating rooms, two X-ray rooms, blood bank, laboratories, a 17-bed intensive care ward, a primary ward with 60 beds and two troop compartments with 240 beds; all of which will greatly enhance our medical capabilities.

Additionally, OPNAV has funded and commenced study on a roll-on/roll-off concept. This program envisions the development of a modular type hospital which could be loaded aboard MSC containerized cargo ships to transform them into hospital ships. A simple extension of this concept would allow for the roll-off and establishment of a modular hospital ashore.

Likewise, the Marine Corps has been actively pursuing this problem. On 29 May 1975, a special Marine Corps System Acquisition Review Council meeting was held to determine if the Marine Corps would continue to procure components of the Army's MUST system for Marine Corps medical units. Because of increased costs, extended contractor delays, substandard workmanship, and a desire to outfit four MAF's instead of two, the council recommended and the commandant approved the following recommendations:

- Terminate acquisition of the MUST shelters and the MUST utility element.
- Cancel the special operational requirement for MUST and publish a required operational capability for facilities, support, and transport needs of field medical units in amphibious units.
- Investigate alternative approaches toward satisfying the revised requirements with initial effort directed toward a combination of tentage, environmentally controlled shelters, and standard support equipment.

In August 1975, the Marine Corps Development and Education Command was tasked to develop a Marine Corps environmentally controlled medical system consisting of selected medical functions (surgery, intensive care unit, and a combined laboratory and pharmacy unit) utilizing rigid and knock-down shelters of the Marine Corps expeditionary shelter system. Funds in the amount of $414,000 were provided for FY76 to cover shelter procurement, system design, fabrication and installation of any required modifications, and installation of medical equipment. I am happy to report that these efforts have proceeded to a point where we have just included 11.5 million dollars in our

current POM submission for the procurement of four of these systems, commencing in FY 79.

While the foregoing programs hold promise for the alleviation of some of our problems, they are by no means the total solution to our medical requirements. Any final analysis of this problem must take into consideration the tenacity, professional skills, and devotion to duty which have become the hallmark of the United States Naval Medical Corps. For the past 134 years, you have never failed to provide the physicians, corpsmen and medical support personnel necessary to support the marine operations preceding the Mexican-American War up to and through the Vietnam conflict. You have never failed to respond to a marine's call for "Corpsman".

Somehow, through all of the adversities of war, the strong bond which has united marine and corpsman into an inseparable force has grown. From this mutual respect and trust, it only seems natural that as we marines plan for the eventuality of the next battle, we find you here working to develop better ways to meet our medical needs. It is this sense of esprit de corps which has made the naval service what it is today. As each of you goes about your important tasks here this week, I assure you that for every concept or program that you help to develop, there will be some marine on a distant beach who will be some day eternally in your debt.

In closing, I extend to each of you my sincere wishes for good luck, much success, and a tremendous amount of gratitude.

KEYNOTE ADDRESS

Vice Admiral D. L. Custis, MC, USN

The purpose of this workshop is to establish a set of relevant medical research and development goals that relate specifically to the medical management of combat casualties. Your composition as a "think group" is truly impressive. Your broad cross-sectional expertise is fortified by many, many man-years of firsthand experience in combat surgery, logistic planning and research methodology. You have been there. Each of you, in your various fields, has made major contributions to the multifaceted management of trauma.

Just the other day I saw a cartoon that showed two men of the cloth watching the construction of an ultra modern church. One of them was saying, "It's very nice, but do you think the congregation is ready for bucket pews?" Your program plan states that since the time allotted to the workshop is limited, only two basic issues will be addressed, namely, combat casualty evacuation and treatment. I do not wish to dampen your enthusiasm, but I am constrained to describe reality. May reality strengthen your resolve. Crudely stated, it is not going to be easy to finance the bucket seats when the congregation has lost interest in the entire construction program. Granted, its a poor analogy, but let us use it as a reminder that your effort must not end with this workshop or with the research engendered by it. The most brilliant breakthrough in the working treatment of traumatic shock will be of little avail without the personnel and material resources for its delivery.

I share General Snowden's distress that there is currently not in existence the hardware for adequate medical support of a marine amphibious landing.

Those of you, unfamiliar with the budgetary arena and not understanding the intricacies of resource competition and acquisition, should know that program sponsors with validated requirements often lose. They lose to those with higher priority programs because of, always finite and now austere, funding. You should also know that the Navy Medical Department is not the program sponsor for medical hardware serving the fleet and the marines. While BUMED may take the heat for shortfalls in such hardware, our role is

entirely comparable to a ship's medical officer whose recommendations to the skipper for improvements in ships' sanitation and habitability are those of a consultant and not a manager.

In our advisory capacity, we have urged for several years the construction of a hospital ship, and have considered the LHA, at best, an interim compromise for a dedicated offshore hospital facility. The funds even to study this problem have, up until this year, been decremented; other fleet needs being so critical. Similarly, the funds for acquisition of a 1000-bed advanced base functional component is finally in the FY78 budget, but only tenuously so.

While casualty care begins with acquisition of the tools, it is completed only with the application of professional talent. We have had to remind our critics, time and again, that the primary mission of the military health care system, indeed the sole reason of our existence, is medical support to the nation's operational forces. All of our secondary missions are tied to the striving for quality in a system on constant standby for contingency need.

When the balloon goes up, the contingency response of our three military medical departments can be no better than the strength of the system in peacetime. As you develop your final workshop report, identifying problem areas in the achievement of optimal casualty care, you, too, must register your vital concern lest the integrity of the entire military medical system not be sustained.

To this end, I shall present a short overview of the erosions already inflicted and others yet threatened, the consternations we face, and the paradoxical pressures under which we work. Although I speak for Navy medicine, there is triservice commonality in almost everything I reference.

Three years ago, we launched a comprehensive combination of exciting programs, carefully designed to create a dynamic, regionalized, all-volunteer military medical service with solid defense contingency backup. All were implemented after OSD and congressional approval. You know those programs well. They were military medicines' "spring of hope".

Now, especially during the past year, each program has been either partially or totally compromised. Military medicine has become progressively vulnerable to extramural manipulation. Rulemakers, regulators, analysts and budgeteers exert their influence from power bases located in multiple federal agencies. Benefits and financing wax and wane. For us, the sign of the times, has, indeed, become the dollar sign. The concern for economy and cost containment of a burgeoning budget is understandable and widely shared. The ironies and inconsistencies in regulations and program guidance, however, make it difficult to cope, especially when arbitrary decrements are levied out of

context with responsible planning. The impact can be paradoxically chaotic. Consider some examples:

Item: Perhaps the greatest irony, is that while the OMB study of military medicine documents that health care services in the military medical system are less costly than under CHAMPUS, we continue to be cut the dollars and manpower with which to operate.

Item: In spite of resource reductions, increased patient traffic is being driven from CHAMPUS back into our military hospitals and clinics. The decrease to the 75th percentile in CHAMPUS cost reimbursement, the consequent refusal of many civilian medical care providers to accept our patients, and now, the new requirement that all patient beneficiaries living within a forty-mile radius report to their own military medical facility, only lengthen the queues of irritated patients in our understaffed clinics.

Item: Our understaffing is not a failure to recruit and retain physicians, but rather an imposed shortage of them based on dollar driven reductions in authorized end strength.

Item: Part of that medical officer shortage was to have been compensated by physician extenders. Paradoxically, physician assistant billets were lost in this year's budget.

Item: After having been pressured to civilianize more and more of our military billets, new civilian reductions in force are now ordered.

Item: It had been argued that a reduction in active duty medical manpower could be accommodated by total force integration and greater utilization of our medical department reservists. Now comes a proposal for almost total cancellation of the Navy Medical Select Reserve Program.

Item: Geographic regionalization of our hospitals and clinics, having provided the management means for the most efficient distribution of scarce resources, is paradoxically perceived by our consumers as the cause of resource insufficiency.

In many cases our resource decrements are inspired by pat answers to problems inherent in the private health care sector. The concept of arbitrarily capping allowance for inflation in the private sector has, as its military medical counterpart, total denial of funds to cover any inflation. In addition, halfway through this fiscal year, a horizontal 4% decrement in the Navy medical budget was imposed by Congress. To accommodate this crunch, we have been living off our shelves, reducing civilian employment, deferring equipment replacement and neglecting facilities maintenance.

While the subsidy base, be it government or third party payers, for medical education in the civilian sector is threatened, we are experiencing a progressive erosion in military health personnel education and training funds. There is now a challenge to the justification for any graduate medical education in military hospitals.

This is of particular concern to us. The role of graduate education and continuing medical education as an essential element in quality health care has rightfully become axiomatic. While we are focusing our residency training programs on predetermined needs of the military services, we do not intend to lose sight of our concomitant shared responsibility with the private sector. Large numbers of service trained specialists have left and will continue, ultimately, to leave the military for civilian practice.

This is as it should be, for if we, in the military health care system as sizeable users of medical manpower, were to fail in providing our fair share of essential graduate education, we would become complete parasites on civilian academia. Worse still, military medicine would lose its time-proven, single greatest recruiting and career incentive were its graduate training programs to be destroyed. Costwise, these programs are, for us, bargain based, providing the great bulk of hospital staff expertise and service.

I shall return to this threat again, but first, let me say something about the OMB study. It was launched three years ago at the time the Administration presented the President's Comprehensive Health Insurance Program (CHIP) for legislative consideration. There was, at that time, high expectancy for some definitive congressional action. The authors of CHIP had a clear appreciation of National Health Insurance impact on current federal health care systems, and a suspicion that wholesale transfer of non-active duty beneficiaries out of the military medical system would be cost effective. During the course of the study three developments heavily influenced its outcome. First, Congress became much more constrained and circumspect in its approach to health legislation. Secondly, the study revealed that health care services in the military system were, by comparison, more economical. Finally, the study team came to realize there were, over and above contingency medical manpower requirements, certain additional elements essential to maintenance of a peacetime quality health care delivery system. Notable among those elements are a patient mix in support of medical education, paramedical training, and professional satisfaction.

In my opinion, the OMB study proved to be, in balance, a very constructive effort with recommendations which merit consideration for phased implementation. I refer, especially, to the proposal for a central entity of, as yet, unprescribed structure. One option could be a joint chiefs of medicine services answerable to the Joint Chiefs of Staff. The office could be vested with responsibility for carrying out triservice coordinated planning, programming, allocation of all resources, monitoring and evaluating the CONUS military

health care system. I, for one, am satisfied this does not portent a purple suit, but would mandate integrated triservice health management. It could be a mechanism for fencing required resources for quality care to all beneficiaries, maximizing their most efficient utilization. Coordinated management of CHAMPUS and direct care could also be assured. Operational medical support would remain exclusively under single service purview.

For the first time in history, the three surgeon generals have now been invited to sit down with the staff of the JCS under the sponsorship of Air Force Lieutenant General Casey, the director of J4 (logistics). The purpose is to explore a mechanism for ongoing direct input to, and interface in, the JCS arena.

You may be sure, that high on that agenda will be these four issues:

1. The need for early acquisition of facilities and equipment for combat operational medical support.

2. Refinement of the medical contingency study justifying and restoring realistic medical personnel end strengths to meet the scenario demands of major conflict.

3. Restoration of funds for professional growth programs and protection of patient mix throughout the systems as essential for medical education and training, continuous education and professional satisfaction. If, as some of our adversaries are proposing, military medicine is ever forced into a situation where only, or predominately healthy active-duty young adults are cared for, deterioration of the system will be inexorable. It will never attract the high quality volunteer health professional.

4. Restoration of the Laird Medical MILCON program and acceleration of OPN support.

General Snowden, on behalf of the Navy medical team, I assure you that your kind expression of respect and trust is mutually felt by us for our marines.

The marines have a phrase about a rose garden. The true professionals in military medicine also need only be told how it is. Every one of you has the fiber and resourcefulness to take it from there. Be assured that I, too, in spite of all that I have herein reported and opined, remain an incorrigible optimist.

PLANNING FOR COMBAT CASUALTY CARE

Rear Admiral B. Eiseman, MC, USNR

Future planning is an integral part of most successful organizations. Based on identified goals, long range planning committees are asked to rise above current operational harassment, and to identify policies that will most likely achieve the objectives, even in the unpredictable future. That is why we are here today.

It is particularly gratifying to those of us who have, for so long, been involved in casualty care to see the Navy recognize the prime importance of care of the combat injured. It takes vision to do so while embroiled in the inevitable struggle for sheer survival during peacetime austerity. The easy course is to let problems of casualty management slide, and to assume that old plans and old techniques will suffice in the future. Wisely, this has not been done, and predictably, if we do our job well in the next few days, the future dividends will pay off in salvage of lives and limbs and, perhaps, the outcome of a future war.

The following factors increase both the value and difficulty of long range planning:

1. Time before the plan becomes effective.
2. Unpredictability of future circumstances.
3. Rate of change in pertinent technology.
4. Lead time in needed hardware development.
5. Complexity of the plan.
6. Lack of relation to previous experience.

One could scarcely devise an area that most precisely fits these difficulties than that of combat casualty management. We are caught between our two dynamic professions - Medicine and War. The technology of each changes at a confusing pace. The predictability of the military scenario is extremely tenuous. No longer can we depend on an all-or-none war. We cannot, with certainty, predict where we shall fight, when we shall fight, or with what areas as bases. We must plan, and have specific medical plans, for a spectrum of wars stretching from police actions to all out nuclear warfare involving both our civilian and military populations. The hardware we require

is complex, expensive, requires long lead time for production and may well be outmoded in the time frame in which we must plan.

Let us not spend our precious time today in bemoaning our difficulties. As surgeons, most of us are more interested in solutions rather than in simply defining problems.

Let us first put our problem in its historic context. Our critical abilities and incentive for imaginative planning have lately been sharpened. Winners of wars usually are smugly conservative and unimaginative. They are willing to stick with what worked in the recent past. Howsoever we syrup the matter, we have, in the last 35 years, had a record on one clear win, one tie and one clear loss. There is nothing like a good shellacking, albeit due to political reasons, for sharpening one's attention! It leads to innovative thinking.

It is a good thing that our critical abilities now are sharpened, for we are at a critical military technologic transition point. Having gloried in 35 years where offensive weapons were almost unopposed, we are suddenly faced with new weapons that provide defensive dominance. Let me briefly explain.

World War I was the epitome of defensive dominance. The machine gun doomed millions of men to trench warfare along a miserable 40 mile strip of Europe. Casualties, all with septic wounds, reached definitive care areas after many hours or days lying in the mud. No one could evacuate them.

World War II saw the tank open up warfare once again, for it was relatively invulnerable to machine gunfire. With mobile warfare returned, quick casualty pick up and transportation to forward surgical centers became a reality.

Korea was a throw back, but the helicopter introduced a unique method for quick evacuation to complex concentrations of surgical personnel, all but inviolate from enemy artillery or air.

Vietnam, of course, was the epitome of offense dominance. I need not tell this audience how total air superiority and helicopter availability provided an unreal wartime ability to provide fantastic concentrations of efficient medical care for the combat casualty.

But then came the Precision Guided Munition (P.G.M.). Used in large numbers for the first time in the Mideast War of 1973, the various combinations of conventional bombs, shells and rockets can now infallibly be guided to targets by radar, laser, heat, infrared and other rays. Their code names, such as TOW, Saggaser, Sapper, Dragon, SAM, cruise missiles, etc. need not concern us in detail. The facts are that such advances in the technology of warfare have suddenly changed the entire format of military medical planning. No

longer can we rely on immune helicopter pick up. They will be knocked from the skies just as predictably as they were over Tang Island at the time of the Mayaguez incident a year ago or along the Suez in 1973.

So, too, will these P.G.M.'s knock out conventional ambulances and military medical concentrations, be they complex, above ground, field or evacuation hospitals or hospital ships. In an era of defense dominance, medical men, just as their line counterparts, have to disperse, howsoever inefficient this may be.

I have dwelt on the effect of combat technology on combat casualty care for a good reason. It is not an accepted tenant, yet, it is absolutely vital in our future planning. Future combat casualty planning must be organized to involve both medical department and line combat planners at every level. We have not time, today, to expand on this important theme.

Let me next list some of the reasonable assumptions on which the plans we make in the next three days might be based.

1. The most certain assumption is that the medical aspects of the next war will not be like the last, in Vietnam. That probably was the last of our leisurely wars. The plan we now devise, and the equipment for combat casualty care on hand at the beginning of the next war, will probably be that which will be operative during the entire conflict. It is unlikely that we shall, again, have the luxurious months and years to change plans and equipment in mid-war, or to have untouched, unbombed civilian economy at our beck and call. It is also unlikely that medical affairs will be given the high priority afforded during the Vietnam War.

2. We shall not enjoy unlimited air power. Helicopters, the essential feature of primary casualty evacuation in the 1960's cannot be relied upon. Extraction from the hot-zone of wounding to a point of initial surgical care will almost certainly have to be by wheeled and, perhaps, armored vehicles, or even by hand litter.

3. As a result, the majority of casualties (or so we had better plan) will not be given initial definitive surgical care within 1-3 hours, as in Vietnam, but rather within 1-3 days. Many will die forward of surgical care. Many who reach the surgeon will have infected, not merely contaminated, wounds.

4. Forward hospitals will probably be under rocket, missile or artillery fire.

5. There will be competition for medical personnel, supplies and equipment for civilian casualty care.

6. Radiation or burn casualties from tactical nuclear weapons is almost a

certainty.

7. Neither troop nor medical facility concentration, be it on land or afloat, will be immune from missile attack. Concentration of forces, a fundamental Napoleonic military tenant of efficiency and effectiveness, will probably have to be sacrificed as providing too tempting a guided missile target. Dispersion, both afloat and ashore, however inefficient, is an unwanted, but inexorable, dictum when offensive weapons dominate.

8. The nation, even in wartime, will insist that medical methods be cost-effective. Both civilian and military health care, whether we like it or not, now is considered merely another public utility. Neither emotion nor bygone historical prestige can be relied upon to carry much future clout.

9. The mechanics of war in this technologic age change rapidly, and with each change subsequent combat casualty care is altered. Professional isolationism between combat technologists and medical department is a luxury we cannot afford. Neither we nor our line counterparts can make future plans apart from each other.

Such assumptions provide the medical planner with an awesome challenge. One that can be met intelligently only by medical officers well versed in both medicine and the advanced art and science of modern warfare.

Given these assumptions, let me next suggest some promising areas of research in military traumatology.

Surgical research is band-wagon oriented. A popular research item like a catchy tune, is played beyond the bounds of reason. Once a subject like electrolyte imbalance, adrenal response, mechanical device assist, RDS, or cell mediated immunological response becomes fashionable, it attracts vast numbers of second-rate minds and first-rate quantities of research grant dollars. I cannot predict the future spending mood or isolationism index of the country, but I plead that the hard-won military medical R&D dollar should be jealously withheld from such blatant "me-too" research. Funding of marginal research protocols allegedly to up-grade a residency training program, characteristically, is both scientifically unproductive and is of marginal educational benefit. Three factors should dictate expenditure of the military research dollars: 1) originality, 2) military relevance, and 3) can the military do the job as well or better than a civilian laboratory already engaged in the project.

Let me briefly list some of the areas where I think the military R&D surgical dollars might be well directed.

1. New synthetic oxygen containing fluids for resuscitation. We have

peaked in evaluating standard colloids and crystalloid solutions for resuscitation. We have long since wrung everything but the extravascular space dry in studying saline overload as it relates to R.D.S.

2. New armored and modular ambulances and new techniques arising from the burgeoning field of emergency medical services.

3. Intra-aortic balloon assist, pacemakers and other mechanical devices for cardiac support following trauma.

4. Head injury is that anatomic zone of greatest mortality, morbidity and social cost, and post injury cerebral edema the usual final pathway of death. Fundamental pharmacologic and surgical research should support projects designed to alter post injury brain swelling. The role of twist drills cranial screws fitted with pressure monitors, and deep sedation while the patient is on the ventilator are specific areas that deserve support.

5. Spinal cord and peripheral nerve regeneration.

6. Sepsis and multiple organ failure. Injured patients who reach a hospital alive rarely now die immediately of their wounds. They die of stress bleeding, R.D.S., liver or kidney failure or D.I.C., all of which are, usually for obscure reasons, related to sepsis. CONUS hospitals were filled with these unfortunates during the Vietnam War. Their number, predictably, will increase in the future as we become more expert in mechanical and pharmacologic individual organ support. What could be more relevant to the military than to study the relation of sepsis to post injury multiple organ failure and better methods of therapy?

7. Pharmacologic methods to achieve heat, cold, altitude, or motion acclimatization. Wars always seem to be fought in inconvenient places, and at least during the last 35 years, in my experience, in bad weather. Environmental casualties often directly effect the military decision at critical tactical moments. They, therefore, warrant continuous military research support.

8. Better methods for bone fixation and chest wall stabilization following flail chest.

9. More efficient means for weaning patients from respirators.

10. Methods for growing blood in mass tissue culture for transfusion.

11. Methods for monitoring tissue pO_2 with small mass spectrometers. These might be used to give objective evidence of the extent of tissue removal for debridement.

12. How to counteract new drug resistant bacterial strains, now made possible by the awesome mutagenic properties of the Sendai virus.

13. Original techniques for managing radiation injury. Almost any military investigator seriously studying nuclear injuries should be supported for I am haunted by our unpreparedness and, indeed, intellectual rejection of the idea of nuclear casualties. All military and political signs, of those who might be our future antagonists, point toward their planned use of tactical nuclear weapons. Yet, we physicians all but ignore the threat or, at least, accept the possibility with a polite shrug and reference to some 10-20 year old manual. Realistic planning must include the likelihood of combined radiation and missile injuries in a future war. Inevitably, our surgical decisions will have to be based, in part, on the likelihood of survival from the irradiation alone. For example, it obviously would be foolhardy to undertake even simple debridement of an extremity wound in a patient whose probability of survival from radiation is only five percent. An entirely new set of probability factors will have to be considered by the military surgeon in the future. It behooves those of us planning during the peacetime to establish the data base upon which such grave judgmental decisions must be made.

Animal models could be used to create a family of curves predicting survival with a given dose of radiation alone, and then in combination with given levels of surgical intervention varying from Class I simple tube thoracostomy or wound debridement, for example, to Class X combined thoracoabdominal, cranial and extremity wound care.

Basic to any such study will be exact determination of the amount of radiation a casualty will have undergone. Radiation dosimetry badges are worn by everyone of us who works in a radiology laboratory or around isotopes. I suggest it mandatory that the dog tag of the future contains a similar radiation monitor plate that can (perhaps with a color code read-out) instantly indicate the recent exposure of the casualty.

For later determinations - which will forcefully dictate surgical therapy - perhaps we shall have to find methods to determine circulating T-cell concentrations in the field.

We, as surgeons, must also become involved in improved means of treating combat casualties with radiation exposure. Why should not every soldier, sailor or marine, upon completion of basic training, have 50-100 ml of bone marrow stem cells withdrawn, frozen and stored in a well protected bank. Then, when word is flashed by satellite to the bank headquarters that a soldier has been thus irradiated, his own cells would be located by computer and sent to him for thawing and reinfusion as an autotransplant. All such technology now exists.

14. New biomedical technology. The military surgeon must constantly

monitor what new technologic device might help in wartime casualty care. Would, for example, the stapling device not have a place in a forward hospital to speed performance of bowel anastomosis? Where, too, should the solid state electrocautery units, now miniaturized and made simple and rugged, fit into the performance of definitive surgery in the field? Certainly Betadine needs re-evaluation, as it now is used as a cure-all for wound care. So, too, does the whole field of prophylactic antibiotics in the care of missile wounds, as they subsequently create resistant strains of organisms, need re-evaluation. Monitoring devices for the shocked patient multiply almost like young rabbits. Central venous pressure is already an accepted technique. Where will the Swann-Ganz pulmonary artery catheter, the CSF pressure monitor, or the thermodilution cardiac output unit fit into the management of combat casualties ten years from now? It is up to us to predict and to keep reviewing our predictions each year.

These are the scientific gauntlets that I throw down to you for solution. They are obviously but a sampling, but I hope I have given you a taste of the type of thinking that will be required for us to meet the surgical needs of the future.

This is neither the time nor the place to list the equally challenging managerial, logistic, command and control and administrative decisions that have to be made regarding combat casualty care. How can inevitable dispersal best be achieved with medical personnel spread thin by civilian needs with a bombed continental United States? What is the role of the physician assistant, of telemetering, or television monitoring? Is there any place for a hospital ship or submarine hospital facility? How can we improve, more than we have in the recent past, in reviewing lessons learned by others and ourselves in current wars? What is the best administrative structure for determining clinical policy or military research application review, or indeed research planning such as we are charged to perform today? How should all of this combat casualty planning be integrated? These, and a hundred other, challenges exist for those military medical officers who have chosen an administrative, not a purely scientific or clinical, career specialty. No one in a senior military medical capacity should be allowed the luxury of ignoring future combat casualty planning. It is a part of your job.

Perhaps the main reason a senior military surgeon, and a reservist at that, has been chosen to deliver this challenge today, is that those of us who have lived through a reasonable segment of history appreciate that military decisions - that in retrospect seem easy and, indeed, often inevitable - are, in fact, painful and agonizing in the reality of the moment when the future is uncertain. The challenge of the moment now is no easier, but certainly no more difficult than many of our predecessors in this country have faced for two centuries. We are fortunate to be able to meet in this place on this beautiful, peaceful spring day and contemplate our future course for combat

casualty care without the pressure of events forcing hurried and only partially thought-out answers. Let us take advantage of this opportunity. We owe it to those who will be our patients on some future battle field.

THE TECHNICAL WORKING GROUP AND ITS ROLE IN FUTURE MEDICAL RESEARCH AND DEVELOPMENT

Arthur B. Callahan, Ph.D.

When one looks at the history of medicine, it is apparent that the role of the military medical services has had tremendous influence on the advancement of medical science. Perhaps the conditions of crisis and emergency under which they function have had much to do with this. In the 200-year history of the United States, the Medical Corps of our armed services have established a truly impressive record of achievement in the advancement of medicine; Beaumont, Reed and Cushing to name just a few of the better known contributors. In every conflict in which the United States has been involved, one can demonstrate significant improvement in the surgical treatment of combat casualties and in the reduction in disease in military personnel.

Weapons and tactics in warfare never remain static. We have always been extremely competent in applying the newest and most sophisticated technological advances to the conduct of warfare.

In no small part, the success of military medical services in the improved treatment of combat casualties has resulted from a parallel application of advanced technology to the practice of military medicine. To quote an old cliche, "The only thing constant is change". As tactics, weapons and technology change, medical treatment of combat casualties must also change. Note in this last sentence, the verb is must change, not should change. We are working with imperatives rather than alternatives.

That, quite simply, is the reason we are assembled at this workshop: to decide what these changes will be.

While the goal or objective of this workshop may be stated very simply, the achievement of this objective is far more difficult due to the complexities and uncertainties of the system under consideration. Not only is there a vast amount of technology which can be applied to military medical practice, there are complexities of how much of it is to be applied, and how is it to be applied. There are uncertainties as to the conditions under which it will be applied: the theatre of action, the environment, the tactical situation, enemy strength and a myriad of other complex uncertainties. There is, in fact, an

immediate requirement to define the current problems in military medical care and devise improvements, in addition to the requirement for advance planning in combat casualty care.

The fact that the tasks, the planning and the decisions faced by the U.S. Navy Medical Corps are tremendously complex does not, however, mitigate or reduce the responsibilities and obligations of the Bureau of Medicine and Surgery and the U.S. Army and Air Force Medical Services: that of providing the highest quality and most efficient medical care to combat casualties.

We have no alternatives except to face these problems, these uncertainties and these complexities.

The mission for formulating advance concepts in combat casualty care in the context of what has previously been discussed rests, in the Navy, with the Naval Medical Research and Development Command. But, the R&D Command is composed of a limited number of people. This imposes a limitation on the amount of experience which is available to be brought to bear on a problem of very large magnitude and scope.

It is necessary, therefore, to enlarge the reservoir of experience by selecting the specialists represented here. It is in this reservoir of experience that we shall find experts who are intimately familiar with the "on-scene" problems of combat casualty care, who can extrapolate a particular tactical situation, or potential situation, into an appreciation of possible problems with our current casualty care management system.

It is of the utmost importance that we settle on issues and techniques of combat casualty care which have a commonality of application across a variety of tactical situations. Casualty care requirements which demand a capability which may not be available, such as helicopter evacuation, are of little use. Requirements which impose undue burden on operational capability and efficiency of a combat unit are unacceptable. On the other hand, excessive compromise at the expense of the quality of combat casualty care is also unacceptable.

The job ahead is a difficult one. You have been provided with a single guiding principle within which to frame your technical deliberation. That is, in the foreseeable future, the care of combat casualties will continue to be on an echeloned arrangement. How casualty care within these echelons will be handled, and how it will be improved within echelons will be the subject matter on which you will apply your experience and judgement. It is a very important task. The results of this technical workshop will influence directly the medical research and development programs of the U.S. Navy and eventually, Department of Defense doctrine on combat casualty care. What is decided here can directly affect the quality and extent of care which future medical officers will be able to provide to combat casualties.

I feel, personally, that there is a certain urgency for the purpose of this workshop. When one reads the newspapers about the chaos throughout the world, with seemingly a new crisis or trouble area with each passing month, one can certainly feel confident in predicting at least a continuing unstability in the world situation for which we should be prepared. This workshop can serve a very important role in that preparation.

The problems of which I have spoken are obvious to all in the audience. The point that I have tried to make is that these problems will not be solved by any small group in Washington. They will only be solved by the combined experience, the combined judgement, and through the interaction of the experts represented at this workshop.

Report of the

Subcommittee on

Primary Casualty Care

REPORT OF THE SUBCOMMITTEE ON PRIMARY CASUALTY CARE

INTRODUCTORY REMARKS

The potential role of the corpsman was considered in a future scenario where the helicopter may not be able to be used as it was in Vietnam. In other words, the corpsman may be responsible for holding the casualty for a few hours, at least, and then providing for his entry into the evacuation system in a manner that delivers him to the next echelon in as stable a condition as possible.

The surgeons expect several things from this corpsman. They would like him to have the potential of initiating replacement fluids, initiating antibiotic therapy, controlling hemorrhage, ensuring a patent airway, and immobilizing fractures.

Several facets of medical support pertaining to primary care are involved: training for the corpsman and the layman; supplies and equipment to the lowest echelons of treatment, and transport of the casualty to the next indicated echelon. With these ideas in mind, the subcommittee examined the current, and imagined the future. These efforts must result in concepts that will benefit the casualty on the battle front.

HIGH PRIORITY

PROBLEM: Composition of Unit-1 (surgical instrument and supply set, individual) as regards antibiotics and analgesics.

CONTRIBUTING FACTORS: The relief of pain and prevention of infection during early evacuation of casualties by the corpsmen, while establishing adequate safety and efficacy precautions, must be kept uppermost in this consideration. Replacement syrettes are no longer available, and antibiotics are not now included in syrette form.

GOALS: Broad spectrum, injectable antibiotic with: low incidence of side effects and allergic reactions, long shelf life, and ease of determining if

material is no longer potent or is damaged.

One dose injectable analgesic for intravenous use with extended shelf life.

RESEARCH AVENUES: Develop a Unit-1 with crystalline (powder)/fluid system as an item to be easily mixed at the time required by the aid man. Both analgesic and antibiotic should be single-dose injection systems. Multiple units should be provided to the aid man. This concept should be applied to both the antibiotic and the analgesic capability.

HIGH PRIORITY

PROBLEM: Present intravenous resuscitative fluids are not entirely adequate as a blood substitute from both the volume replacement and the oxygen carrying capability.

CONTRIBUTING FACTORS: Severely injured casualties, often in shock, require large amounts of intravenous fluids. Oxygen exchange and transfer are often compromised in these patients. Volume expansion is needed to restore tissue perfusion and vital signs toward normal until adequate whole blood supply is available.

GOALS: To obtain an alternative to whole blood that would adequately replace volume and that has the capability of carrying and transferring oxygen to the tissues. In addition, a prolonged circulation time of up to 4-6 hours may be desirable.

RESEARCH AVENUES: Investigate hemoglobin solution as 1) a replacement fluid, especially in the exsanguinating patient, until whole blood is available, or as 2) a resuscitative fluid, early in the treatment of casualties. Other solutions, e.g., fluorocarbons, could also be investigated for their oxygen carrying capability, if their administration is compatible with conventional medical therapy.

Animal models have been developed, and organ safety is currently being evaluated with respect to hemoglobin solution.

HIGH PRIORITY

PROBLEM: Administration of intravenous fluids should be initiated at the earliest echelon of treatment.

CONTRIBUTING FACTORS: In the midst of combat, the corpsman should not

have to make sophisticated treatment decisions regarding what type of fluid to use. The gravity flow dependent mechanisms for delivering these fluids is, at best, precarious.

RESEARCH AVENUES: Further development of this concept should be considered within the following constraints:

a. Develop/identify one fluid to be used by the line corpsman.
b. The fluid should be maintained in a relatively stable environment to alleviate adverse physiological effects of administering fluids that are too hot or too cold.
c. A constant pressure/flow device should be developed to eliminate inherent problems of maintaining a gravity flow system.
d. The solution of choice should be stored in a non-breakable container.
e. The solution should not be plasmanates or albumin.
f. Ringer's lactate is suggested as the best currently available fluid for this purpose.
g. Volume should not exceed 500 ml.
h. Bag/container should include an 18-gauge intracatheter.

MEDIUM PRIORITY

PROBLEM: Costs, in terms of both money and shipping space, attributable to transport of intravenous fluids to resupply points are considerable. Once available, storage problems and significant space requirements occur.

GOAL: Develop a method of manufacturing intravenous fluids, ashore and afloat, in the theater of operations.

RESEARCH AVENUES:

- Develop methods for using onhand pyrogen-free water supplies to hydrate prebagged powdered additives.
- Adapt currently available technology, such as shipboard evaporation equipment and milipore filters.
- Develop a simple portable method for rendering onhand water sterile and pyrogen-free. An ideal would be a single-size tablet that readily dissolves in a measured quantity of water.

MEDIUM PRIORITY

PROBLEM: The present Emergency Medical Tag requires an unrealistic amount of writing.

CONTRIBUTING FACTORS: Excessive information is required to be entered on the casualty tag. In combat trauma casualties, the diagnosis and treatment

are readily apparent (except for medications). In a firefight, time does not permit accurate recording of these facts, and the diagnostic ability of the company aid man is insufficient to be of subsequent value. The problem is aggravated by darkness, and darkness combined with inclement weather.

GOALS: Develop a tag using tear strips (or similar methods) which requires a Yes/No indication for analgesics, antibiotics, and intravenous fluids. Additionally, since the company aid man is the most likely person to have the identification capability, it would be desirable to have a space for an ID tag imprint or, in the absence of a space, to write the man's name on the card. An alternative to tear strips might be perforated punch-outs for medication recording.

RESEARCH AVENUES: Search for the optimum material capable of receiving imprint easily, which accepts ballpoint pen, is strong and relatively impervious to moisture, dirt, heat and cold. It is recognized that the present tag is STANAG item, but effort is still needed for improvement.

MEDIUM PRIORITY

PROBLEM: Practical training mannikins for corpsmen.

CONTRIBUTING FACTORS: Certain procedures are taught didactically to the corpsmen, with little actual opportunity to perform the procedure. Some techniques should actually be practiced before the corpsman is given the instruments with which to accomplish the procedure.

GOAL: Teach the corpsman to become aware of clinical indications for the procedure, and then to perform it competently.

RESEARCH AVENUES: Develop a teaching/training manikin that would incorporate the following features:

a. A selection of varying types of facial injuries with varying degrees of demonstrable respiratory embarassment.
b. Selective pulse, skin color, skin temperature combinations to simulate degrees of shock.
c. Neck features to enable the repeated practice of cricothyroidotomy.
d. Upper extremity features to permit repeated practice of intravenous administration of fluids.

LOW PRIORITY

PROBLEM: Case, surgical instruments and supply set, individual (Unit-1)

has proven to be less durable than the old type because of lightweight nylon material used in its construction.

CONTRIBUTING FACTORS: The nylon is easily torn and snagged in field use. Closures, such as zippers and buckle straps, are frequently torn or ripped away, permitting spill of the contents.

GOALS: Construction of a more durable case (Unit-1).

RESEARCH AVENUES: Return to canvas materials as previously used in older model cases (Unit-1).

LOW PRIORITY

PROBLEM: Present inflatable splints are not well suited for field use due to propensity for puncturing plastic, and problems associated with zipper-type closure.

CONTRIBUTING FACTORS: Plastic is easily punctured under field and combat conditions. Dirt and non-sturdy zippers prevent proper use of zipper-type closure.

GOALS: Develop puncture-proof inflatable splint utilizing a lacing eyelet-type closure.

RESEARCH AVENUES:
- Explore utilization of protective covering over present splint.
- Explore utilization of heavier plastic with less likelihood of puncture.
- Explore possibility of different type of compound capable of being utilized in Kevlar.

LOW PRIORITY

PROBLEM: It is conceivable that future military engagements may occur in cold or even arctic environs. While there has been considerable research on the effects of cold and the treatment of frost-bite, a number of problem areas remain.

CONTRIBUTING FACTORS: What is the physiology of cold acclimatization? Experiments should be designed to develop a pre-injury physiologic profile. Particular attention to be directed toward alterations in rheology of blood and plasma flow as well as biochemical parameters. What is the ideal fluid to be used in resuscitation of a battle casualty in an arctic environment?

Does a patient in hypovolemic shock in the arctic respond systematically in a manner similar to one in a temperate or tropical climate?

GOALS: Design of a cold weather boot which "breathes". While the existing boot has proven to be warm, problems occur when the wearer has to move a considerable distance on foot. Moisture, which cannot escape, develops rapidly; this, in time, leads to immersion foot problems.

RESEARCH AVENUES:
- Develop lightweight, flexible, cold weather clothing for use by corpsmen. In the field, care of casualties necessitates corpsmen being exposed to cold or sub-zero temperatures. A protective glove needs to be designed which will permit the field corpsman to have the necessary flexibility to perform his tasks, yet which will provide him with sufficient protection so that he will not become a casualty himself.
- Investigate and determine the most suitable intravenous fluid for optimal resuscitation of casualties in an arctic environment.
- Study the pathophysiological response of hypovolemic shock under arctic conditions.

LOW PRIORITY

PROBLEM: Should the G-Suit ("shock trouser") be available for use in initial therapy of the battle casualty in shock?

CONTRIBUTING FACTORS: Shock from hemorrhage is a contributing cause of mortality in the battle casualty. Recently, the G-Suit has been used by paramedics for initial treatment of civilian trauma victims. The clinical impression of doctors responsible for the definitive care of these patients is that rapid application of the G-Suit at the scene of the accident has improved survival. Understandably, this is just clinical impression lacking any objective data. There is some evidence from animal experimentation that use of the G-Suit is detrimental. Since potential benefits of the G-Suit are substantial, this controversy should be resolved by a randomized prospective study.

GOALS: Clinical evaluation of the G-Suit in the treatment of hemorrhage and shock.

RESEARCH AVENUES: A prospective, randomized clinical study should be supported to evaluate the G-Suit in the trauma victim who is is shock from blood loss. This should preferably be done in a clinical setting where there is a large population of victims with penetrating trauma, and adequate paramedical support.

LOW PRIORITY

PROBLEM: Protection of intravenous fluids in temperature extremes.

CONTRIBUTING FACTORS: Administering fluids that are either too warm or too cold.

GOALS: Maintaining intravenous fluids, to be delivered to the company corpsman, within acceptable temperature limits until actual turnover to the corpsman.

RESEARCH AVENUES:
- Determine the physiologic effects of administering hot and cold intravenous fluids.
- Define acceptable limits, if above indicates adverse effects.
- Develop insulated chest with racks for fluid containers, with the chest having a simple mechanism to maintain selected temperature ranges.

LOW PRIORITY

PROBLEM: Consultative services to the independent duty corpsman.

CONTRIBUTING FACTORS: The independent duty corpsman at sea is occasionally faced with questions concerning the management of a patient, with no medical officer in the vicinity.

GOALS: Provide the corpsman with the capability to transmit symptoms, signs, X ray, electrocardiographs, etc., to a distant medical officer acting as a consultant.

RESEARCH AVENUES: Continue refinement of telemetry ship-to-ship and ship-to-shore.

LOW PRIORITY

PROBLEM: To control "stump" hemorrhage following traumatic amputation.

CONTRIBUTING FACTORS: The initial treating corpsman needs a dressing which can be quickly applied in the case of traumatic amputation, and which is effective in stopping blood loss so that attention can be directed to associated injuries.

GOALS: To prevent further blood loss/shock, allow immediate attention to associated injuries, require no further attention (other than surveillance)

until arrival at definitive care facility.

RESEARCH AVENUES:
- Adaptation of present inflatable splints.
- Explore pliability and reliability of plastic in extreme temperatures.
- Explore possible need for relief valve, if inflatable and if air evacuation is envisioned.

LOW PRIORITY

PROBLEM: Treatment/transportation of non-walking wounded in extreme combat temperature.

CONTRIBUTING FACTORS: Extreme cold presents danger of hypothermia to patient, and danger of local injury to corpsman treating injured.

GOALS: To make available to the injured patient an environmentally controlled module having access ports to allow essential care by corpsman and to allow transportation without further deterioration of the patient's condition due to ambient temperature.

RESEARCH AVENUES: No basic research needed. This would be an engineering fabrication effort.

Report of the

Subcommittee on

Field Casualty Evacuation and Hospital Care

REPORT OF THE SUBCOMMITTEE ON
FIELD CASUALTY EVACUATION AND HOSPITAL CARE

INTRODUCTORY REMARKS

The problems associated with field casualty evacuation and hospital care are extensive. To all intents and purposes, the stage of equipment in casualty evacuation and field hospital operations existing today is the same as it was in Korea with the exception that more advanced clinical technology has been superimposed. Basically, the organizational patterns involved in combat casualty care have only recently become attuned to possibilities of different modes of management.

There is infinite variety of strategic and tactical considerations in casualty evacuation and field care. The helicopter will probably not be able to be used as effectively as was previously done. Therefore, consideration should be given to other evacuation methods such as the surface effect vessel. A paramount consideration in any evacuation concept should be the condition, comfort and welfare of the patient in the evacuation system.

There are problems with diagnostic and treatment equipment to be considered. Decisions must be made as to the kinds of diagnostic equipment required, and to the level of complexity and sophistication which can be accommodated. There is need for standardization of military medical equipment and modular construction to facilitate maintenance and repair.

There is need to look, again, at preventive medicine in the field. This effort can prevent more disease than the whole medical world combined could ever treat, to say nothing about cure.

The problems addressed are grouped into two essentially different but complementary groups. One related to evacuation, the other related to field hospital operations in the form of a marine element in the field.

HIGH PRIORITY

PROBLEM: Inadequate means for blood component therapy in combat.

CONTRIBUTING FACTORS: The restoration of blood volume with crystalloid or colloid solutions is the primary goal in the immediate treatment of the wounded. Lactated Ringer's solution is a stable solution that must be readily available. A stable hemoglobin solution or an artificial oxygen carrier may be useful during the immediate resuscitation. The treatment with blood products such as fresh whole blood obtained from the available donor population, stored whole blood, or stored red blood cell concentrate (hematocrit 70v%) requires that these blood products are available and properly preserved, and that blood typing and cross-matching facilities are available. Stored whole blood contains preserved red blood cells and the plasma proteins - albumin, globulin and fibrinogen. Platelets, granulocytes, and plasma protein clotting factors deteriorate during storage of whole blood at +4C. These substances produce microaggregates which require that the blood products be filtered through effective filters. Routinely, whole blood should be prepared into red blood cell concentrates with hematocrit values of 70v%, platelet concentrates, and fresh frozen plasma within four hours of collection.

Blood components prepared shortly after collection can be preserved using liquid and freeze technology. Red cell concentrates with hematocrit values of 70v% can be stored at +4C for as long as whole blood. The temperature of +4C can be maintained during shipment using wet ice or eutectic salts. Red cell concentrates contain less plasma, less white blood cells and platelets ,less anticoagulant, and less isoagglutinins than whole blood.

In addition to the red cells to improve oxygen transport to the tissue, platelets and fresh frozen plasma may be needed to treat bleeding disorders associated with deficiencies of platelets and plasma clotting factors.

Red blood cells can now be easily frozen with the cryoprotective agent, glycerol. The addition and removal of 40%w/v glycerol from the red blood cells have been standardized. Washing of the red blood cells to reduce the glycerol to less than 1%w/v is essential. A unit of frozen red blood cells can be washed within 35 minutes with 2.5 to 3.2 liters of sodium chloride solution.

The red blood cells frozen with 40%w/v glycerol can be stored at -80C for at least ten years. These frozen red cells can be shipped in a polystyrene foam container with dry ice.

Recent advances in freeze technology have demonstrated that outdated red blood cells can be biochemically modified with solutions containing pyruvate, inosine, glucose, phosphate, and adenene (PIGPA). This approach has military relevance and will permit the salvaging of outdated C positive and O negative red blood cells, at the site, for subsequent use. Biochemical modification prior to freeze preservation will improve red blood cell viability and

function. Red blood cells with improved capacity to deliver oxygen to tissue can be prepared by this operation.

The technology of biochemical modification, freezing, and washing of red blood cells requires appropriate hardware, software, space and technician support.

Frozen red blood cell technology can now be used to supplement the liquid stored red blood cell program in the field. The frozen blood bank can also provide frozen platelets. The same hardware, software, space and technical support can now prepare frozen red cells and frozen platelets. Platelets are frozen with DMSO and stored at -60C.

The potential use of autologous shed blood by recovery at the operation site, filtration, and reinfusion requires further study prior to any recommendation. The safety and efficacy of all blood products must be maintained by having proper equipment available and technical support.

GOALS: To develop improved methods for making available all components of blood for use in combat situations. Substitutes for components (e.g., artificial oxygen carriers) should be considered where feasible.

RESEARCH AVENUES:

- Continued research on safety and efficacy of hemoglobin solutions and artificial oxygen carriers.
- Continued research on oxygen transport function of preserved red blood cells.
- Continued research on the function of preserved platelets (liquid and frozen) to correct dilutional thrombocytopenia.
- Research on the therapeutic effectiveness of preserved granulocyte (liquid and frozen) to treat patients with agranulocytosis in septic shock.
- Modification of human red blood cells to provide universal donor red blood cells for transfusion without cross-matching.
- Continued research to evaluate the effectiveness of blood filters to remove microaggregates from blood products.
- Research in the freeze preservation of stem cells for the treatment of irradiation injury.
- Research to determine therapeutic effectiveness of fresh frozen plasma in the treatment of bleeding disorders.
- Feasibility studies to interphase the present liquid blood banking system with the frozen blood banking providing frozen red blood cells, frozen platelets, and fresh frozen plasma on land and aboard ships.
- Safety and therapeutic effectiveness of autologous blood obtained from abdominal and thoracic surgical sites.
- Improve technology for thawing frozen blood products.

HIGH PRIORITY

PROBLEM: Identification, measurement, and treatment at field level of injury from conventional weapons, our own as well as the enemy's.

CONTRIBUTING FACTORS: Requirement for "need to know" communication between weapon systems development commands, intelligence, and medical department personnel of what weapons, friendly and enemy, are in use, available, and potentially utilizable.

GOALS: Methods to identify which injury, and measurement of degree of injury sustained from these weapons. Education of medical personnel relative to the evaluation and treatment of these injuries.

RESEARCH AVENUES:
- Review what has been done.
- Continue such research. The Army has a program at Edgewood Arsenal which should be continued and supported and which, in the future, could be assumed by or augmented by the surgical research program. This thought envisions studies of animal wounds for type and extent of tissue damage, both obvious and delayed, and the development of tissue damage indicators, possibly by probes, to measure tissue electrolyte levels, oxygenation, pH, etc.

HIGH PRIORITY

PROBLEM: How to monitor, diagnose and treat the effects of special weapons (CBW and E/M).

CONTRIBUTING FACTORS: In contingency planning, non-conventional warfare must be considered in planning for casualty care. Medical personnel must be kept abreast of the effects of these special weapon systems. Newer weapon systems are continually being developed but their effects are not fully known. The medical service must be prepared to treat these "wounds", even in peacetime from training accidents, e.g., laser injuries.

GOALS: To develop personnel badges/dog tags which could detect and measure the degree of exposure to such agents, e.g., ionizing/electromagnetic radiation, chemical, and biological.

RESEARCH AVENUES: Continuing medical/surgical research, including animal studies, studying exposure effects, types of wounds, and developing indicators of exposure. A program of continuing education for medical personnel is required.

MEDIUM PRIORITY

PROBLEM: Need for adequate blood gas analysis. Basic care of the seriously wounded battle casualty, today, requires assessment of blood gas and acidity. Identification of, and optimal treatment for, acute respiratory insufficiency dictate that measurement of blood pH, pO_2, and pCO_2 be readily available at the field (2nd echelon) level. Development of the portable ventilator makes this requirement more cogent.

CONTRIBUTING FACTORS: Blood gas analysis is now a necessary adjunct to proper patient management.

GOALS: To develop a blood gas analyzer capable of operation by relatively inexperienced hospital corps personnel, rugged enough to withstand the rigors of field use, and small and light for easy transport. The instrument should be adaptable to a field generator electrical power source (with its inherent voltage variances), have an alternative internal power source (i.e., rechargeable battery), and be adaptable to shipboard use. Field maintenance and repair should permit easy replacement of electrodes and other parts. The specimen chambers should require a minimum of rinsing to permit frequent determinations.

RESEARCH AVENUES: The U.S. Army Medical Research and Development Command is presently engaged in development of a prototype for field use. The Navy should become involved to the extent necessary to meet this requirement.

MEDIUM PRIORITY

PROBLEM: Blood cell counter and hematocrit determinations. Care of seriously injured patients requires rapid determination of hematocrit and white blood cell counts. Massive transfusion, with its production of thrombocytopenia, requires determination of platelet counts. Hematocrits have, heretofore, been available only after centrifugation, a time consuming process when multiple major casualties are received simultaneously.

CONTRIBUTING FACTORS: Technologic advances make this technique available and state-of-the-art, now.

GOALS: Development of compact, light, self-contained, easily usable device (in commercial production for civilian use at the present time) for hematocrit determination. Assessment of its accuracy and adaptation of the device to field use is necessary. Adaptation of the coulter counter to field determination of white blood counts and platelet counts should be undertaken. Requirements for such adaptation should include reduction in size and weight, minimizing the size of sample and volume of reagent required, and minimizing preparation of the sample for machine use. It should be accurate with the

voltage variations inherent in field generators, and have internal alternative power supply. It should be rugged enough for field use and capable of maintenance and repair or replacement by general duty hospital corps personnel.

RESEARCH AVENUES: This is the kind of project in which the U.S. Army Medical Research and Development Command has had considerable experience. Liaison with that group would seem appropriate.

MEDIUM PRIORITY

PROBLEM: Serum (and urine) electrolyte determination, management of fluid and electrolyte therapy of seriously injured patients, requires availability of a minimum of sodium and potassium levels in serum and, if feasible, in urine. Serum chloride and carbon dioxide determinations would permit a more complete assessment of fluid and electrolyte status. Recognition of low calcium state is not now available in the field.

CONTRIBUTING FACTORS: This is state-of-the-art and accepted as a necessary patient management adjunct.

GOALS: Development of hardware to provide this information is considered imperative in modern day care of seriously injured patients. It must be simple enough to permit use by general duty corpsman in the field, small and light enough for easy transport, yet rugged enough to withstand the rigors of field use. It should be capable of accurate determinations with the wide voltage variations inherent in field generators and preferably be capable of its own power supply (e.g., rechargeable battery) in the common event of generator power loss.

RESEARCH AVENUES: This is the kind of project in which the U.S. Army Medical Research and Development Command has had considerable experience. Liaison with that group would seem appropriate.

MEDIUM PRIORITY

PROBLEM: Field medical X-ray equipment authorized for TO & E units in the combat zone does not satisfy the diagnostic requirements for patient care support.

CONTRIBUTING FACTORS: X-ray equipment presently available in the Army divisional medical companies is inadequate. The equipment authorized the Combat Support Hospital (CSH) in direct support of the division is too heavy and bulky. In both of these cases, temperature sensitive film and solutions

are required, creating a tremendous logistical burden. Currently available equipment does not meet requirements for rapid triage, especially in mass casualty situations, wherein real-time visualization of whole body penetrating fragment dispersal and vascular damage must be rapidly assessed prior to initiation of treatment.

GOALS: There is need for a rapid, reliable means of performing total body scanning of a combat casualty as far forward as the tactical situation will permit with a reduction in the logistical support required. The X-ray scanning system must be compatible with acceptable diagnostic standards of image resolution. Magnification of a portion of the image is desirable. There must be a capability of electronically storing and/or transmitting an X-ray image to a central rear area to permit diagnosis and guidance in the absence of an on-site radiologist. The device must be capable of scanning casualties without their removal from the standard NATO litter. The X-ray tube and receptor components should be moved, rather than moving the patient.

RESEARCH AVENUES: Subsequent to the introduction of X-ray detection equipment at airports, the U.S. Army Medical Research and Development Command initiated a feasibility study to explore the possible adaptation of this technology as a diagnostic tool in a combat medical support environment. An experimental prototype will be completed by the end of 1976. Further evaluation and advanced development of a ruggedized device for field use was indicated.

MEDIUM PRIORITY

PROBLEM: There is no satisfactory medical method available in the field to treat rapidly cold injuries of the extremities.

CONTRIBUTING FACTORS: Operations in extremely cold climates are productive of seriously disabling cold injuries of the extremities, especially among unacclimatized troops. Remote geographical locations contribute to the difficulty of providing adequate medical care for cold injury casualties because of a paucity of medical facilities which can be positioned and maintained in extremely cold climates, where transportation is encumbered by snow, ice and storms. Cold injuries must receive prompt and carefully controlled rewarming. Treatment, according to best medical principles, consists of rapidly warming the injured tissue in a circulating fluid ranging from 104 F to 109 F. This method prevents more serious injury resulting from multiple primary and secondary cold injury, and helps prevent infection caused by improper handling of the injury due to lack of proper equipment. The very limited resources available at forward medical aid stations place severe constraints upon the size, weight and electrical power consumption of cold injury rewarming equipment.

GOALS: Design of a "suitcase" size or smaller device which can accommodate

the foot, a short distance above the ankle, and the hand, a short distance above the wrist. This device may consist of a collapsible tank which is sufficiently large to permit adequate fluid flow and turbulence between its sides and the extremity. The associated apparatus must provide thermostatically-controlled water heating and pumping action at a rate up to 45 gallons per minute in the prescribed temperature range. The minimum therapeutically effective circulation rate should be determined through medical investigation and experimentation so that equipment size, weight and power consumption can be held to parameters which are in keeping with hand-carry, quick warmup and easy stowage. A gross limitation of 3 kw power consumption, with an objective of 1 - 1/2 kw is sought.

RESEARCH AVENUES: The U.S. Army Medical Research and Development Command should task its developing agency, the U.S. Army Medical Bioengineering Research and Development Laboratory to perform the necessary study, equipment design and evaluation. Working prototypes should then be tested in an extremely cold climate of the type likely to produce cold injuries. There is not contraindication to definitive medical treatment through use of prototypes meeting the above criteria since resuscitative care would be accomplished in similar manner without the use of accurately controlled temperature and water circulation.

LOW PRIORITY

PROBLEM: There is presently no shipping container which will adequately keep freezable medical items of supply at the required temperature levels during transport.

CONTRIBUTING FACTORS: Medical personnel in Alaska and Europe have reported that, even under peacetime operations of short duration, freezable solutions and medical supplies are subject to deterioration while being transported. No accurate estimates as to dollar losses are available. Of more significance is the fact that in actual combat situation, intravenous fluids and other critically needed supplies will not be available for immediate life saving measures to stabilize a combat casualty prior to evacuation.

GOALS: There is an immediate need to develop one, or a series, of lightweight, ruggedized shipping containers that will maintain freezable medical supplies at controlled temperature levels. The containers will be used to support daily operations, tactical moves, depot to unit shipments, and for both warehouse and outside storage of freezable medical supplies. A temperature monitoring device providing audiovisual warning for malfunctioning is required.

RESEARCH AVENUES: The U.S. Army Medical Research and Development

Command recently developed a six cubic feet, 60 pound, electrically operated, exploratory prototype container. This was given a limited test in the arctic in January 1976. The proposed course of action requires incorporation of modifications in design and operating characteristics based on the evaluation data received from Alaska. An advanced development prototype will be fabricated and should be operationally tested by medical field units during the winter of 1977.

LOW PRIORITY

PROBLEM: Need for improved methods to maintain various temperatures that are required to ship red blood cells (+4C), frozen blood (-80C), and platelets and fresh frozen plasma (-30C).

CONTRIBUTING FACTORS: Presently, either wet ice or dry ice in large quantities is employed to refrigerate whole blood/packed cell and frozen blood/fresh frozen plasma, respectively. Wet ice must be re-iced in 24-48 hours maximum, and dry ice in 48 hours; both are ambient temperature dependent. Large amounts of wet (14 lb) and dry (30 lb) ice are required. Wet ice bags break or leak, and blood labels are washed off. Field ice producing machines are unpredictable and require parts, power, etc.

GOALS: A reusable system; smaller, lighter, self-contained refrigeration packs; longer refrigeration periods to eliminate re-icing; and compatibility with polyurethane shipping containers.

RESEARCH AVENUES:
- Test and evaluate existing systems, temperature maintenance, for field use, i.e., eutectic salts or chemical compounds.
- Modify and improve to meet requirements - hot or cold ambient temperature (presently not satisfactory).
- Develop methods to modify chemically blood and blood components so that more realistic temperature may be employed.

LOW PRIORITY

PROBLEM: Sewage wastes and other toxic/contaminated waste products must be disposed of with as little degradation of the environment and danger to the health of personnel as possible. This problem is of particular significance in medical elements where, in addition to normal human waste products, such things as tissue, organs, surgical dressings and other organic and inorganic wastes are generated.

GOALS: Develop for each medical company of the medical battalion a self-contained

disposal system, preferably within an ISO configured container (8X8X20) or smaller, that is operable in all climatic conditions and which will produce a relatively sterile/safe effluent that can be easily discarded without hazard to personnel or the environment.

RESEARCH AVENUES: Monitor current efforts being done by the Army and Marine Corps, ascertain state-of-the-art, and develop a better energy form, preferably non-fossil, and in as compact a total system as possible.

LOW PRIORITY

PROBLEM: Large quantities of surgical and ward linens are generated by units of the medical battalion. Since there is no provision for laundering these items, they must be transported to another facility. The time lag involved can create critical shortages due to limited supply, distances involved to the laundry facility, and its workload.

GOALS: Develop the capability for each company of the medical battalion to have its own laundering capability, perhaps with dual-purpose personnel showering facility, in a container no larger than ISO standards (8X8X20) which is operable in all climatic conditions.

RESEARCH AVENUES: A three-chamber module of an ultrasonic sound cleansing chamber, extractor chamber and a microwave dryer chamber seems feasible if adequate and economical utility systems can be developed or adapted for this purpose. MCDEC, Quantico should be contacted to determine any efforts they have initiated in this regard.

LOW PRIORITY

PROBLEM: To improve the environment of patient movement vehicles.

CONTRIBUTING FACTORS: The severity of the shock, vibration, pitch and noise of the present field ambulances (particularly the M-792, 1-1/4T, 6X6), and other vehicles frequently pressed into ambulance use, preclude proper enroute patient care and further degrade/aggravate injuries. The problems associated with the M-792, originally surfaced by NMFRL, Camp Lejeune in 1966, remain unanswered.

GOALS: An improved environment for the ground transportation of casualties.

RESEARCH AVENUES: Program tapes of ride characteristics of designated ambulance vehicles and undesignated vehicles used as ambulances should be developed. Ride simulation, utilizing animal models, can be used to determine physiological effects and methods for dampening adverse ride characteristics.

LOW PRIORITY

PROBLEM: To determine the need for and characteristics of new means for surface evacuation of casualties.

CONTRIBUTING FACTORS: The proliferation of hand-held anti-aircraft weapons and the likelihood of less than total air superiority in future operations jeopardize the role of the helicopter as the primary casualty evacuation means.

The intensity of armored combat, such as that experienced by the IDF in the 1973 Yom Kippur War, precludes the use of conventional ambulances or other "soft" vehicles for casualty evacuation. The IDF has modified a number of tank chassis by removing the turret and replacing it with an armored compartment and using this armored ambulance to move casualties from the point of injury rearward several kilometers where they may be evacuated further by surface or air.

The seaborne nature of USMC operations dictates the need to use amphibious vehicles, such as the LVTP7, as ambulances to reduce the need for transfer of patients when evacuating seaward.

The use of multiple layers of soft armoring materials, such as DuPont's Kevlar, presents the opportunity to armor vehicles with small weight penalties.

GOALS: The identification of alternative means for the surface evacuation of casualties.

RESEARCH AVENUES:
- Review IDF experience in the conversion and use of armored ambulances.
- Determine the feasibility and desirability of using surface effects vehicles as amphibious ambulances. Review of previous efforts in the study of vibration and noise associated with SEV's should be carried out.
- Determination should be made of the Marine Corps' plan to provide additional armor in the LVTP7.
- Although litter carriers have been designed for the LVTP7, consideration should be given to the development of an ambulance kit.

LOW PRIORITY

PROBLEM: The existing medical evacuation bag for transport of combat casualties in extreme cold climatic zones has proven to be unsatisfactory.

CONTRIBUTING FACTORS: The evacuation bag presently in the inventory was designed prior to the Korean War. Because of an existing large inventory of that evacuation bag, no major effort has been made to make improvements.

Recent winter exercises in Alaska have made it very clear that an urgent need exists to improve upon the existing bag, or to develop a new one. In addition, the relatively enormous electrical power required to maintain the casualty for up to eight hours in temperatures as low as -40 F precludes use of batteries, which are bulky and very inefficient at low temperatures. The weight and fuel requirements of gasoline-powered electrical generators preclude their use in a casualty evacuation package. Other systems, which use open flame, pose hazards to patients and operating personnel.

GOALS TO BE ACHIEVED: There is a need for an improved capability to sustain a casualty during evacuation under severe cold conditions.

RESEARCH AVENUES: The U.S. Army Medical Research and Development Command and the Naval Medical Research and Development Command have approached this problem. They have looked at the feasibility of developing an electrically heated liner, the development of a new bag in conjunction with Natick Development Command, and other approaches. The most recent effort is a contract to develop a unique liner which may be utilized with the existing evacuation bag or with a second generation new bag. The approach is through a contractual effort utilizing a propylene gas-powered device. The propylene gas in a catalytic unit provides a low hazard heating source in an extremely small weight and cube container which can accompany the bag. The effort is intended to develop a device which will automatically, economically, and safely provide a small, lightweight heating source which can easily accompany casualty evacuation bags, and which will supply heat for up to eight hours at low (-40 F) ambient temperatures.

LOW PRIORITY

PROBLEM: The existing field sterilizing equipment methods leave a broad latitude for improvements. The need for increased simplicity, efficacy and reduced size and weight of equipment and supplies is of paramount importance to field medical units.

CONTRIBUTING FACTORS: Present and projected sterilization means demand excessive space and weight plus extensive logistical support in the nature of high tonnage items such as gasoline. In addition, present sterilization means further increase the logistical support burden by utilizing methods that damage certain medical items (i.e., surgical gloves, rubber/plastic tubing) in the sterilization process, and which in themselves, are a large factor in wearing out the sterilizer.

GOALS: To determine and identify the most efficient and bacteriologically safe system of providing required material of guaranteed sterility at the user-patient level of any echelon of medical service in the field.

including unconventional conflict and internal defense operations. Resultant system would be simple, compact and lightweight in design, applicable to medical, dental and veterinary requirements and appropriate for disposable and non-disposable supplies for on-site use and with packaged pre-sterilized supplies.

RESEARCH AVENUES: The task of identifying and developing the most efficient and microbiologically sound equipment is being accomplished in two phases under the purview of the U.S. Army Medical Research and Development Command. The conceptual phase, phase I, was devoted to studying the problems. Phase II, or the final phase,has seen a processing system designed and exploratory prototypes being fabricated based upon the phase I recommendations and conclusions. All prototypes will be evaluated for reliability, availability, and maintainability for operational effectiveness and military utility. Items being developed and very near completion are: a) emergency sterilizer, b) steam vacuum pulse sterilizer, c) ethylene oxide sterilizer, d) power module for steam vacuum pulse and ethylene oxide sterilizers, 3) evacuation injector sealer.

Other research avenues that should be explored include the possible use of ionizing and microwave sterilization.

Report of the

Subcommittee on

Shipboard Casualty Evacuation and Care

REPORT OF THE SUBCOMMITTEE ON SHIPBOARD CASUALTY EVACUATION AND CARE

INTRODUCTORY REMARKS

The overall approach of the subcommittee was to identify specific problems regarding the shipboard treatment and evacuation of combat casualties as derived from a common perception of the total system and its individual components currently addressing this patient care requirement. It was recognized that the care requirement encompasses those combat casualties generated, both afloat and ashore, during the conduct of naval operations. It was considered that existing shipboard systems can be roughly equated to the system ashore...that ships with battle dressing stations are equivalent to the battalion aid station. Ships designated as casualty receiving and treatment ships are equivalent to medical companies and hospital companies. Hospital ships are equivalent to the advanced base functional component of 400 beds or larger. It was noted that no ships, other than a hospital ship, have the primary mission of treatment and evacuation of combat casualties. This was considered a significant deficiency. It was agreed that the shipboard treatment and evacuation of casualties remain a valid requirement for support of naval forces and that, initially, support from this source will be the only support available during the conduct of amphibious operations. The current absence of an unaltered hospital ship, or other available platform dedicated solely to medical support was of concern. It was unanimously felt that this represented a significant and serious decrement to medical support to the operating force. It was also agreed that a coordinated shipboard system for the treatment and evacuation of combat casualties is required with no acceptable substitutes being identified or envisioned.

HIGH PRIORITY

PROBLEM: Blood-banking techniques aboard ship.

CONTRIBUTING FACTORS: Except for prior hospital ships and selected amphibious ships with augmented surgical teams, blood-banking aboard ships has been limited to the "walking blood bank" concept. Use of the "walking blood bank" removes healthy, functional men from their billet for a definite period of time.

GOALS: Develop blood-banking techniques applicable to the different levels of care, e.g., tactical ships, as a CV, LHA with embarked surgical team. Study means of providing blood to fleet units reducing the need for a "walking blood bank".

RESEARCH AVENUES: Expand the Navy's blood research program, as necessary, to fulfill this need.

HIGH PRIORITY

PROBLEM: X-ray units that are portable are not adequate for shipboard use. They either give poor pictures, are difficult to develop, or are too heavy for a rolling vessel.

GOALS: Improved X-ray units as to weight and quality of pictures. Ease of developing the exposed film is an important consideration.

RESEARCH AVENUES: Develop new technique or method with equipment to replace current shipboard equipment.

HIGH PRIORITY

PROBLEM: Intravenous administration with hanging bottles and tubing is a hazard for transportation, and requires overhead heights which may not be present in transportation vehicles.

GOALS: Develop method of administering fluids which does not require elevation of container and yet is not a hazard for injection of air. Develop some form of pressure bag or bottle that can be placed under patient on stretcher during transportation.

RESEARCH AVENUES: Develop intravenous containers to meet above goal.

HIGH PRIORITY

PROBLEM: Traumatic injury is often aggravated by iatrogenic injury.

CONTRIBUTING FACTORS: Initial casualty care is necessarily conducted by relatively inexperienced personnel. This includes corpsmen, medical officers and dental officers.

Current war surgery manuals (e.g., Emergency War Surgery, CINPACFLT Conference) are written by experienced specialists and are designed to guide

definitive care as it would be done by them. Less highly trained specialists may find it difficult to apply safely these methods.

Once definitive care has been given to a casualty, his attendants often assume that he is ready for evacuation. Review of the case by a suitable specialist may not occur until it is forced by advanced morbidity which becomes obvious a day or two later during transport. This situation occurred over and over again as casualties came through Clark AFB in the Philippines during the Vietnam War. Emergency inspection, there, of the patient frequently showed that the morbidity was a result of the care rendered as much as of the wounds received.

GOALS:

- A war surgery manual written solely for the least experienced, least trained members of the casualty care team.
- New knowledge about conservative methods of casualty care which preserve life and function but avoid iatrogenic injury.
- A casualty staging plan which provides specialty review prior to transport of the casualty for long distances, and prompt specialty care for cases treated conservatively by general medical personnel.

RESEARCH AVENUES:

- Review of each common type of major war injury to suggest conservative methods of care which will tend to avoid iatrogenic injury, preserve life and give later specialty care the best chance of success. Expected prolongation of hospitalization can be defined. This can be shown to be a good trade-off versus death, more prolonged permanent disability which may result from improperly performed definitive care.
- Testing of the proposed conservative methods of care in the field or in smaller hospitals where specialists are not available. For example, a study to show that many chest wounds are best managed without the immediate placement of a pleural drainage tube. Simple chest physiotherapy antibiotics, avoidance of fluid overload, and surface transport to specialty care will probably give excellent results. Thoracentesis can be used if one time chest evacuation is needed.

HIGH PRIORITY

PROBLEM: Selection of life support/monitoring equipment for shipboard use.

CONTRIBUTING FACTORS: There is a lack of standardization in the selection of this equipment not only between ships (even of the same class) but with fixed facilities. Health care personnel are too often unfamiliar with the equipment they find they must work with aboard ship. A considerable amount of

shipboard equipment is inappropriate for shipboard use because environmental suitability is lacking. Reliability and maintainability are very often a problem.

GOALS: Equipment should be standardized. Naval hospitals should be equipped, to some extent, with the same life support/monitoring equipment selected for shipboard use allowing orientation of medical personnel prior to their duty aboard ship.

Criteria for selection and standardization of this equipment should include: suitability, adaptability, durability, maintenance, space and personnel requirements. Specific attention must be given to the specific problems associated with a shipboard environment, e.g., vibration, motion, noise, electric power, and electronic emissions.

RESEARCH AVENUES:
- Identify what equipment is required.
- Identify what equipment is already available and what has to be modified or developed.
- Test and evaluation in both hospital and shipboard environments.

HIGH PRIORITY

PROBLEM: There is no stock item for a chest drainage system.

CONTRIBUTING FACTORS: The "Heimlich Valve", used widely in Vietnam, is no longer available.

The three services have never agreed upon specifications for a chest drainage system.

Each military hospital prefers to order their local preference via open purchase.

GOALS: Triservice agreement on specifications for: a) chest tubes, b) chest drainage collection set, c) chest suction source.

RESEARCH AVENUES: Recommend triservice meeting with attendees as follows: chest surgeons, general surgeons, nurses, and surgeon general office representatives with authority to agree on type classification.

HIGH PRIORITY

PROBLEM: Data collection and feedback to physicians and corpsmen in the field.

CONTRIBUTING FACTORS: The massive casualty workload often results in

failure of medical personnel to complete required medical records. Lack of feedback prevents change or correction in treatment procedures.

GOALS: A simple method of data collection with information forms that are compact and easy to complete, i.e., check off list type.

A computer that allows feedback from CONUS to the primary care area.

Real time reporting system that provides update information on patient status.

RESEARCH AVENUES: Develop real time system for data report and feedback on patient status and treatment procedures.

HIGH PRIORITY

PROBLEM: Sterilization techniques are presently hazardous, unreliable and slow.

GOALS: A method of sterilization not subject to vagaries in valves and plumbing. Sterilization procedures must be rapid to allow reuse of material during maximum use periods. Sterilized gear must maintain sterilized condition for long shelf life.

RESEARCH AVENUES: Develop sterilization technique which meets above goals.

MEDIUM PRIORITY

PROBLEM: Adverse effect of noise and vibration on patient and medical personnel.

CONTRIBUTING FACTORS: Ships internal machinery (engine, shaft, screws, AC); deck operations, e.g., anchor chain, chipping, launching, small boats, drilling and hammering, Unrep and Vertrep; helicopter operations; ships' whistles, blowing tubes, communication system; proximity to combat environment; centrifuges, suction machines, chest suction machines, respirators (medical treatment equipment).

GOALS: Reduction in ambient noise levels and vibrations emanating from ship's operations.

Improved soundproofing in patient area.

Development of quieter medical treatment equipment.

Use of individual personnel paging devices for minimizing use of public

address systems within hospital spaces.

RESEARCH AVENUES:
- Study of noise pollution and vibration aboard ship.
- Research and development of quieter medical equipment.

MEDIUM PRIORITY

PROBLEM: Adverse effect of environmental factors: a) hostile ambient temperature and humidity, and b) temperature acclimatization for casualties brought directly from high temperature areas into air conditioned environment.

CONTRIBUTING FACTORS: Operating in tropical or sub-tropical areas. Polar or cold weather environments.

GOALS: Air conditioning and/or heating of patient care spaces to comfortable temperature and humidity.

Intermediate temperature zone for gradual acclimatization of casualty to prevent sudden chilling.

RESEARCH AVENUES: Study effects of temperature and humidity regulation on patient comfort, and effect of rapid changes in ambient temperature on chilling.

MEDIUM PRIORITY

PROBLEM: Bacteriologic pollution of patient area by aerosolization. Cross-contamination by medical attendants of pathogenic bacteria, fungi and other microorganisms from open wounds. Introduction of vectors to ship, e.g., parasite, bacterial, fungal, viral, from foreign environment and/or by indigenous personnel.

CONTRIBUTING FACTORS: Contaminated open wounds; patients with respiratory infections; colonization of medical personnel by staphylococcus; indigenous disease vectors, e.g., TBC, malaria, dysentery; tropical diseases; lack of public health control ashore.

GOALS: Bacterial and other microorganism filtration/scrubbing system for ventilation system. Bacteriologic control of open wounds by bacteriocidal/static agents, e.g., Povidene, iodine, or other dressing agents. Quarantine of organisms from each patient, e.g., handwashing, isolation techniques. Protection against introduction of vectors to ship.

RESEARCH AVENUES:
- Preventive medicine units.
- Navy medical research units.
- Surgical wound research.

MEDIUM PRIORITY

PROBLEM: There is need for a better method of conveying patients from site of injury to site of definitive care, i.e., a better "stretcher" system to be integrated with a life support cart system.

CONTRIBUTING FACTORS: Traditional stretchers a) afford little patient protection in transit, b) have to be hand carried, c) do not provide ease of movement of patient from triage to X ray, on and off X-ray table, etc., d) do not provide life support or vital sign monitoring while patient is in transit.

RESEARCH AVENUES:
- Develop a better stretcher.
- Develop a life support cart onto which stretcher can be placed for those patients requiring such support as ventilatory, temperature, intravenous drug support, and patient monitoring of vital signs, EKG, etc.

MEDIUM PRIORITY

PROBLEM: Shipboard casualty care is seriously complicated by contingencies of chemical, biological and radiological (CBR) warfare.

CONTRIBUTING FACTORS: Ships do not have efficient, proven decontamination and environmental protection systems.

Casualties do not have a badge to indicate the level of radiation exposure.

Best methods of counteracting chemical warfare are poorly understood by medical officers.

Material condition "Zebra" and "Circle William" aboard ship impedes casualty movement and care.

It is not known how radiation or chemical exposure alters the prognosis of war injuries.

GOALS: Design and fabrication of a "badge" to be worn by combatants which will reveal radiation exposure, and perhaps certain expected chemical exposures as well. Design shipboard material conditions which will provide environmental

protection against radiation and airborne chemicals but still permit the orderly flow of casualty care into and within medical spaces.

RESEARCH AVENUES:
- Medical department participation in fleet drills involving CBR warfare. Mass casualty management should be added to these training exercises.
- Common war injuries should be studied in relation to concomitant radiation or chemical injury. A table of prognosis can be developed to assist the triage officer under these circumstances.

MEDIUM PRIORITY

PROBLEM: Present casting requires holding and moving extremity while wrap around dressing is applied.

GOALS: A method of casting which allows non-movement of extremity and rapid setting with ability to bivalve.

RESEARCH AVENUES: Develop inflatable splint with a quick setting, lightweight material injected. Will require ability to manipulate fractures and maintain traction while setting which is not available in present inflatable splints.

MEDIUM PRIORITY

PROBLEM: Anesthesia equipment for shipboard/field use.

CONTRIBUTING FACTORS: Anesthesia equipment used in fixed hospital facilities is not always appropriate for shipboard/field use.

Currently available "portable" or field-type" anesthesia machines are inadequate and/or unsafe.

RESEARCH AVENUES: Develop an appropriate anesthetic delivery system appropriate for use in the restricted shipboard environment or field.

LOW PRIORITY

PROBLEM: There is a lack of uniformity in the management of thermal burns.

CONTRIBUTING FACTORS: Difficulty in assessing the extent of the injury, i.e., tendency to minimize surface and pulmonary effects. Lack of standardization of immediate care. Preparation of patient for initial evacuation to an intermediate facility where fluid and colloid management can be provided. Difficulty in managing complications, e.g., infection and renal function.

GOALS: Establish a set of criteria to assess extent of injury and need for further intensive care.

Establish standard technique for immediate care and preparation for evacuation to next echelon.

Design a burn treatment protocol suitable for shipboard use.

Establish shore based (CONUS or other, remote from theatre area) burn-treatment centers for definitive care.

RESEARCH AVENUES: The state-of-the-art exists for good burn treatment. What is needed is:

- Training at the primary (immediate) care level.
- Standardization of care at that level.
- Method of evaluating injury and determination as to the requirement for next level of care.
- Preparation of patient for evacuation to next level of care if indicated.

LOW PRIORITY

PROBLEM: Transportation of severe injuries in shock-like state with minimal fluid replacement from front line to resuscitation unit.

RESEARCH AVENUES: Development of a shock trouser that would both immobilize lower extremity fractures, and maintain abdominal pressure for stabilization of patient.

LOW PRIORITY

PROBLEM: Need for an anesthetic drug that can be administered by general medical officers to do debridements and multiple dressing changes.

GOALS: An anesthetic drug that has no respiratory or cardiac effects, but good analgesia for extremity wounds. Must not have neurologic or hallucinogenic effects present with Ketamine.

RESEARCH AVENUES: Develop animal and clinical research models.

LOW PRIORITY

PROBLEM: Motion sickness complicates the management of battle casualties and adversely affects efficiency of care provided.

CONTRIBUTING FACTORS: There appears to be inadequate treatment and/or prophylaxis for motion sickness.

RESEARCH AVENUES: Develop a better method of motion sickness prophylaxis and treatment.

Report of the

Subcommittee on

Strategic Evacuation and Inflight Casualty Care

REPORT OF THE SUBCOMMITTEE ON STRATEGIC EVACUATION AND INFLIGHT CASUALTY CARE

INTRODUCTORY REMARKS

The strategic aeromedical evacuation system is currently charged with the transportation of groups of stabilized patients from theater hospitals to CONUS hospitals. Selection of patients for these flights utilizes criteria against which the patient can be measured in a standardized manner. The subcommittee reviewed the general criteria and wound specific criteria proposed by the five CINCPAC Conferences on War Surgery held between 1967 and 1971. These general criteria were 1) stable hematocrit of 35%, 2) stable vital signs, 3) no active bleeding, 4) adequate hydration.

These general criteria remain valid. Subcommittee members did, however, have questions regarding the evolution of the accepted hematocrit level; this was addressed as a specific problem.

Wound specific criteria were also reviewed. The subcommittee felt changes or final approval of these criteria should come from medical specialists in orthopedics, neurosurgery or vascular surgery, as examples.

Questions arise as to the distinction between strategic and tactical aeromedical evacuation. The present system presumes adequate hospital/medical personnel resources in theater, and retention of the current flexible evacuation policy. The strategic evacuation system may be required to transport a large number of minimally stabilized patients if the evacuation policy is shortened, or if inadequate hospital beds or medical personnel exist in theater. This would require that a larger number of cargo aircraft be available to the air evacuation system, that these aircraft be capable of modification, that more trained personnel be dedicated to air evacuation crews (including physicians), and that there be more sophisticated monitoring/diagnostic equipment for in-flight use.

HIGH PRIORITY

PROBLEM: Is the current criterium regarding the hematocrit level appropriate?

CONTRIBUTING FACTORS: "CINCPAC" Conference of War Surgery and the NATO Handbook, Emergency War Surgery, 1975, values changed from 30 to 35 to 30%. Patients who appeared stable in Vietnam post-surgery, e.g., amputation, were given transfusions in order to meet the hematocrit criteria for aeromedical evacuation. Physicians ordering this blood felt it inappropriate, at times.

GOALS: Evaluate the effects of transient altitude exposure to 8500 feet (cabin altitude) on patient survival, wound healing and physiologic and metabolic rate of the patient: a) validate the patient hematocrit values utilized, or b) propose other criteria such as level of tissue oxygenation which may be more appropriate.

Develop equipment/training required for prolonged in-flight monitoring of less stable patients.

RESEARCH AVENUES: Utilize appropriate animal models to study specific diseases and trauma effects on response to treatment.

HIGH PRIORITY

PROBLEM: There is an extremely limited capability for the strategic movement of large numbers of unstable patients.

CONTRIBUTING FACTORS: Current doctrine directs transport of stabilized patients from the communication zone to the CONUS. The fluidity of the battle situation may deprive U.S. forces of definitive hospital care in land or sea-based facilities. The type of warfare (nuclear, biological, chemical) may require evacuation of an existing hospital. There may be unforseen rapid increases in casualty rates. There may be an absence of other means of evacuation or inaccessiblity of alternative secure medical treatment facilities.

GOALS: Development of levels of in-flight casualty care capability. This capability should include: a) scheduled evacuation of stable patient, and b) evacuation of unstable, critically injured patients from a threatened area or as dictated by the exigencies of the situation.

Expanded in-flight casualty care requires certain functional elements: resuscitation, emergency surgical management, blood banking, and diagnostic laboratory capability.

RESEARCH AVENUES:

- Develop and utilize appropriate animal models to study specific diseases and trauma effects on response to treatment during in-flight evacuation.
- Current research underway on laboratory equipment for shipboard use may apply, and should be assessed for in-flight use.

HIGH PRIORITY

PROBLEM: Existing aeromedical evacuation equipment does not fully realize the current state-of-the-art for patient care.

CONTRIBUTING FACTORS: The combat zone tactical and medical situation may necessitate the strategic movement of patients who have not attained optimum clinical stability.

GOALS: Ensure availability of reliable, adequate suction.

Ensure availability of adequate, reliable ventilators.

Develop equipment and systems to measure pertinent physiologic/metabolic parameters of unstable patients.

RESEARCH AVENUES:

- Field test recently developed suction machines, or develop additional suction machines compatible with future aircraft.
- Adapt existing ventilators to the flight environment, or develop a satisfactory volume ventilator with PEEP, humidification and oxygenation.
- Adapt oximeters, tissue pO_2 probes, specific ion electrodes for electrolyte evaluation, and such other equipment as appropriate to monitor the metabolic state of the patient.

MEDIUM PRIORITY

PROBLEM: Aeromedical evacuation of nuclear, chemical and/or biological warfare casualties.

CONTRIBUTING FACTORS: Combatant personnel may encounter such weaponry. Exposure levels of ionizing radiation may determine the appropriateness of triage for management of associated blast/missile injuries. The subsequent evacuation of such individuals may need to be qualified by consideration of: a) level of radiation exposure, b) time-phase manifestations of "radiation sickness", and c) selecting of the most appropriate time for evacuation of such casualties in view of a and b.

Chemical warfare casualties will require specialized treatment modalities, specialized treatment facilities, patient transport bags, and may raise questions as to feasibility of air evacuation in a chemical warfare environment.

Are there specific diseases which, by virtue of their transmissibility, should not be brought to CONUS, and if not, what special interventions, e.g., isolation equipment, are needed during evacuation?

GOALS: Policy guidelines for management of such problems.

RESEARCH AVENUES: Consultation with experts in these areas directed toward obtaining specific guidelines and education as to these areas of consideration.

Report of the
Subcommittee on
Definitive Casualty Care

REPORT OF THE SUBCOMMITTEE ON DEFINITIVE CASUALTY CARE

INTRODUCTORY REMARKS

Several problem areas have been identified in which research avenues have been described. Other problem areas are only identified.

In every area identified, it is certain that basic and clinical research have to be joined to improve effectively the definitive care of the combat casualty. Historically, the lack of ongoing programs during peacetime prevents the continuity of education and training required for the best care of the combat casualty. To this end, it appears obvious that the best use of research dollars to benefit the combat casualty must be spent in the establishment of combat casualty research centers such as the existing burn unit. Nuclei for these centers are already in existence in the U.S. naval system: Trauma Unit, San Diego; Radiation Exposure Unit, Bethesda; and Transplantation Unit, Bethesda.

It is imperative that clinical research units be identified and supported with funds and personnel. A trauma (combat casualty) research unit must be established at this time. An overseas location in a country with much trauma and few indigenous physicians would be a possibility.

Although the presence of the USUHS might provide some source of support in the trauma area, their mission does not include the responsibility for casualty care. The responsibility for this is clearly the Research and Development Command of the naval health care system.

Disregard for ongoing combat casualty research (dollars, people) during peacetime prevents the readiness necessary to do the job in time of war. These mistakes, in each war, cost lives. We cannot afford to repeat these errors.

HIGH PRIORITY

PROBLEM: Tactical atomic weapons are available and may well be used in future "limited" conflicts. Unlike strategic atomic bombs, these smaller weapons will produce a large number of radiation casualties in addition to

burn and blast injuries. Radiation in excess of 1200-1500 rad probably will produce irreversible, and therefore, lethal effects in exposed troops, even if heat and blast effects are minimal or absent. On the other hand, levels of 400-600 rad may require only supportive therapy with the expectation that recovery of the radiation sensitive bone marrow will occur spontaneously.

Those troops exposed to levels of 600-1200 rad fall into a lethal, and yet potentially treatable category.

CONTRIBUTING FACTORS: Need for increased knowledge and training of all physicians and paramedical personnel in the treatment of radiation injuries.

GOALS: Prevent lethal complications of radiation exposure.

Develop systems for support of radiation casualties of less than 600 rad.

Provide support of patients with 600-1200 rad exposure.

RESEARCH AVENUES:

- Develop dosimetry system that would help in triage selection of high and low radiation exposure casualty.
- Develop system of triage based on degree of traumatic injury as well as level of radiation exposure.
- Study methods to produce maximum yield of cell components for support of the radiation victim.
- Study methods of long-term storage of blood cell components (particularly neutrophiles) for use with mass casualty treatment.
- Study methods of rapid tissue typing and cross-matching to provide compatible platelets and white cells.
- Develop capability for transplantation of bone marrow.
- Develop techniques for use of mismatched bone marrow transplantation to stimulate the patient's own residual marrow.
- Develop techniques to prevent lethal infections which often are the final insult in the radiation patient.
- Develop vaccines to protect troops who are potentially exposed to radiation.
- Study the possibility of collection and study of marrow for treatment of patients.
- Develop immunization against common pathogens which are lethal in aplastic phase of radiation injury.
- Develop methods for long-term storage of autograft marrow for future use in the event of radiation exposure.
- Develop body armour protection for that portion of marrow sufficient to allow recovery even after otherwise lethal exposure - theoretically possible to protect up to levels of 2000-2500 rad.

HIGH PRIORITY

PROBLEM: Mortality from systemic sepsis is very high (50-70%) in the combat casualty. Despite years of clinical and basic science research, the human systems response to infection is not understood. At the present time, only supportive treatment is available (other than drainage of confined abscesses). Antibiotics have not been found to decrease the mortality.

CONTRIBUTING FACTORS: An understanding of disease entity systems responses is needed. Only when the mechanisms are elucidated, will effective prevention and treatment be forthcoming.

GOALS: Improved methods for prevention, identification and treatment of systemic sepsis.

RESEARCH AVENUES:

- Develop immunological profiles before and after injury. Healthy volunteers and existing clinical cases with graded surgical stress could be utilized to determine the degree and duration of immunosuppression, and whether the individual's immune mechanisms are cyclic.
- Determine mechanisms which control the immune response. Develop animal models which can be utilized for the basic research effort.
- Study methods for stimulating the individual's immunologic response to infection. Animal models must be developed first, then the results applied to humans.
- Develop an immunization program for the troops (vaccines).
- Develop appropriate animal models for use in basic research on vaccine development.
- Determine the role of humoral mediators in systemic sepsis.
- Develop animal models for studying the hemodynamic and pulmonary consequences of sepsis.
- Develop better understanding of the importance of metabolic requirements in the septic patients: a) substrate requirements, b) best method for administration, and c) assessment of complications.
- Study clinical cases in existing facilities.
- Define cause and mechanism of stress ulcer and develop improved methods of prophylaxis and treatment.

HIGH PRIORITY

PROBLEM: Central nervous system injury continues to exact a high morbidity and mortality on the combat casualty. In past conflicts, valuable information relating to the character, location, extent of CNS wounding to eventual outcome has been lost because of a lack of concerted effort to establish a research endeavor in this area. Many problem areas could be resolved by

clinical prospective studies in combat casualties and basic research efforts in appropriate animal models. A few of the major problem areas are as follows:

Are prophylactic antibiotics useful in CNS injuries? If so, which antibiotics?

Are prophylactic anticonvulsants beneficial in preventing either early or late post-injury convulsive disorders?

What is the value of brain mass reduction agents in facilitating debridement? That is, is exploration of the wound tract facilitated by such agents? Is there any significant increase in other pathology, such as expanding hematoma, caused by such agents? Can or do such agents mask expanding lesions, thus making detection and proper treatment more difficult?

What is the role of temperature control in prevention of increased CNS injury from brain edema and/or decreased blood flow?

How effective is intracranial pressure regulation by the use of glucocorticoids, hyperosmotic brain mass reduction agents, e.g., mannitol, hypothermia and hyperventilation, based on intracranial pressure monitoring, in alleviating progressive brain injury due to brain edema?

Determinations of indications for, and results of, removal of intracranial bone fragments.

Develop methods to determine the best way to handle injured peripheral nerves to achieve optimal results in later nerve anastomoses or grafting.

The correlation between location, extent and character of CNS injury with eventual outcome (final neurological status, convulsive disorders, etc.) is poorly documented, and can be much more precisely defined if properly studied.

Spinal cord injury (definitive care, rehabilitation) continues to be another unresolved problem area.

Nerve regeneration and repair following injury remains a critical problem. Present research in this area is promising, and further investigation is indicated.

Patients with CNS injury contiguous to bone and bowel injuries present difficult management cases.

The role of computerized tomography in more precise and detailed evaluation of combat injuries should be thoroughly investigated, including the feasibility

of installation of such equipment on hospital ships.

CONTRIBUTING FACTORS: A study group, as suggested herein, was proposed in both the Korean and Vietnam conflicts. In the former, it became operational, as U.S. Navy Neurological Team Number 1, but the study was begun so late that only very suggestive and stimulating information was obtained, while statistically conclusive information could not be obtained. The Vietnam conflict was in its closing phases before the study group proposed could be approved.

During the Vietnam conflict, a Head and Spinal Cord Injury Registry was established, with CNS-wounded patients being entered into the registry by a standardized report form. The preliminary information obtained from the above limited studies demonstrates clearly that a more in-depth prospective long-term study group could provide conclusive information of great value on the previously cited problems.

RESEARCH AVENUES: Of paramount importance in solving the problems presented is the establishment of a neurosurgically oriented research group to study the problems. Potentially fruitful animal model research could be undertaken by this group in nearly all of the problem areas cited above. While the correlation of location, extent and character of CNS wounding with eventual outcome of the wounded does not lend itself to animal model study, the research group could develop the protocol, reporting forms and data assimilation mechanism necessary to study this area most effectively in the event that an armed conflict presents itself for study.

HIGH PRIORITY

PROBLEM: Repair or replacement of lost or damaged tissues/organs as a result of combat injuries. Bone and muscle injury are a devastating problem during conventional warfare. Initial management of these injuries are well defined. The more difficult areas are related to loss of large masses of bone, nerve and muscles from extremity wounds. Future casualties will benefit from the availability of various tissues for transplatation as previously described (nerves, bones, limbs). Other than controlling infection, transplantation offers the best hope of rehabilitating the patient with musculo-skeletal injury from combat.

CONTRIBUTING FACTORS: With the advent of successful tissue transplantation in medicine, the future of transplantation of nerves, bones and entire limbs will be feasible for use in the combat casualty. It is mandatory that a broad based research program in this field be instituted as soon as possible.

GOALS: Capability for long-term preservation and storage of tissues/organs for use in transplantation.

Capability to transplant whole organs and limbs that retain viability and function.

Improve the results of transplanted allogenic bone and fascia tissues. For instance, bone resorption often occurs faster than bone formation.

RESEARCH AVENUES:

- Develop methodology for transplantation of whole limbs and joints. Success depends on the ability to transplant pre-fixed nerves.
- Conduct in vitro and in vivo laboratory studies of the mechanisms of nerve regeneration.
- Develop quality control procedure for allogeneic (treated, preserved) tissues for transplantation. Identify basic standards and recommend methods for evaluating various preserved tissues to comply with these standards.
- Characterize through animal and human studies clinical manifestations of the responses where preserved tissues are utilized.
- Determine the appropriate means of assessing the immunologic feasibility of transplanting preserved tissue, i.e., tissue typing, immunosuppression, preservation.
- Determine the type, quantity, and location of storage preserved tissues for casualty reconstruction and therapy. Conduct retrospective analysis of requirements for preserved tissue therapy and projection of future needs based on current and new tissue biological investigative developments.
- Investigate materials available for vascular grafts, and if needed, carry out further development.
- Determine if oxygen, pH, electrical field, enzymes, or other possible humoral mediators affect the rate of bone growth or wound healing in animal models.
- Develop methods of prevention, early methods of diagnosis, and improved methods of treatment for fat embolism syndrome.
- Develop in vivo and in vitro methods to suppress osteoclast activity in order to prevent bone resorption.
- Evaluate early use of large bone segments in animal models with and without the use of internal fixation.
- Evaluate the use of allogeneic entire joint transplants or hemi-joint transplants in animal models.
- Evaluate the use of allogeneic fascia grafts for joint stabilization in animal models.
- Develop animal models to evaluate new forms of treatment.
- Study human cases to determine better methods of diagnosis (present hospital populations).
- Determine the efficacy of aerosolized antibiotics.
- Joint injury presupposes long term disability in the combat casualty. Determine if artificial joints or methyl methacrylate can be utilized and, if so, determine length of use of these materials in animal models.
- Determine a biological device for use in measuring bone healing in fractures with and without artificial joints and methyl methacrylate.
- Tendon repair and rehabilitation, at present, are rarely successful in combat

casualties. Animal research demonstrates likelihood of possible benefit to humans. Conduct study of humans that need allogeneic tendon transplants (fixed) before and after transplantation.

HIGH PRIORITY

PROBLEM: A severely burned patient is the severest challenge in medical care. His treatment requires an enormous investment of professional resources in terms of physicians, nurses, and laboratory personnel. A seriously burned patient may require several months' hospitalization, initially, and then go through months or years of reconstruction for functional or cosmetic purposes. The direct care costs of a severely burned patient can exceed $100,000. Shipboard burns are a serious peacetime, as well as wartime, problem. The current incidence from the Armed Forces is approximately one severe burn per day.

CONTRIBUTING FACTORS: Initial problems of the burned patient are clotting abnormalities, altered cellular metabolism, wound healing complications, burn wound sepsis, generalized sepsis, unique pneumonias, the requirement for physiologic (or synthetic) membranes to achieve earlier wound coverage, and suppression of protective immunologic mechanisms. Problems at later stages involve the need for improved surgical restorative techniques, physical and occupational techniques, and devices to improve functional and cosmetic results. Thus, the total care of a burned patient involves a multiplicity of disciplines and types of professional care.

GOALS: Improved methods for the care and treatment of seriously burned patients which will reduce the morbidity and mortality associated with such injuries.

RESEARCH AVENUES:

- Evaporative water loss from the burn wound makes it difficult to maintain fluid and electrolyte balance and may adversely affect wound healing. Evaluate and develop methods to control the temperature and humidity of the wound of the burn patient and assess their effect on wound healing, and further evaluation of the role of excision.
- Develop synthetic materials or improve allogeneic skin graft management to cover the burn wound (animal models). For instance, can a topical substance be developed to place on burns to influence favorably healing without promoting sepsis.
- Serious infections with or without pulmonary complications continue to contribute to mortality in burn patients. Develop better understanding of the host defense mechanisms of patients (or animals) who get severe infections.
- Develop preventive methods to protect the patient from pulmonary damage, and better methods of diagnosis and treatment.
- Substrate requirements, proper dietary mix and method of administration of this diet need to be determined in the burned patient. Study specific amino

acid formulas for pharmacologic and hormonal enhancement of nutrition.
- Investigate immunologic support using vaccines, antisera, transfer factor and granulocyte transfusions in the treatment of burn patient.
- Current non-invasive physiologic monitoring in hyper-metabolic patients is too insensitive, and the risks of invasive techniques are sizeable. Develop new monitoring techniques and assessment of usefulness of echocardiography.

MEDIUM PRIORITY

PROBLEM: Retinal scanning and loss of transparency of the vitreous following traumatic injury to the eye are responsible for loss of vision and subsequently loss of the eye.

CONTRIBUTING FACTORS: Recent work that suggest vitreous surgery (removal of damaged vitreous, replacing it with salt solution) can decrease loss of vision and removal of eye.

GOALS: Improved treatment of eye trauma.

RESEARCH AVENUES: Animal models should be used to evaluate the benefit of vitreous surgery following eye trauma.

Report of the

Subcommittee on

Casualty Care Data System

REPORT OF THE SUBCOMMITTEE ON CASUALTY CARE DATA SYSTEM

INTRODUCTORY COMMENTS

The subcommittee concentrated on the collection and communication of clinical as opposed to administrative or resource management data. The requirements for clinical data from each echelon of the medical organization were confined to the minimal information necessary for the treatment of the patient at the next higher echelon. This restriction was imposed by the reality that only brief and readily collected information can be supplied by medical people working under the pressures of combat. In addition, provision was made for completion and forwarding of the patient's treatment record on disposition (discharge or death) at any medical echelon.

Although the scheme described deals specifically with battle casualties in units ashore, the same data requirements are applicable to the equivalent echelons of units afloat. The higher proportion of major injuries among shipboard battle casualties makes rapid collection of succinct data imperative. The system described is designed to accomplish just that.

It is also imperative to note that the system is designed to cope with the high casualty rates anticipated in conflicts comparable to World War II. Such casualty rates may be expected in conflicts where our forces lack air superiority, and consequently lack evacuation capability. These rates are higher than those provided by the USMC casualty planning factors.

The U.S. Field Medical Card (DD Form 1380) as presently designed, is considered to be inadequate both in information requested and the ability to withstand climatic and physical conditions usually met in combat, i.e., injuries, mud, blood, wetness, humidity. As a continuous record of treatment, it is too small and difficult to read. Its redesign and uses will be addressed in the problem list for further study. Whatever form the casualty tag takes, it is suggested that recording of treatment by pencil, or other writing instrument be held to a minimum. Medical supplies and drugs utilized for treatment should be provided with removable labels containing both human and machine readable information. These labels would be affixed to the combat casualty tag, would serve as a record of initial medical treatment, and would subsequently be scanned for logistical inventory control and accounting.

The use of diagrams for surgical treatment records is recommended. These diagrams which would portray body areas and organ systems, should be sufficiently large and detailed to permit indication of surgical treatment by appropriate marks and notes. They should become part of the medical record, and could be designed for coding for data processing by use of X-Y coordinates.

To provide more detailed medical records of later, more complex portions of the treatment, a single encounter form should supplement the initial combat tag. This form should require minimal data transfer from the tag, and should serve as a summary sheet during evacuation.

The military health record assembled in peacetime contains large amounts of information of minimal utility in the care of combat casualties. It is recommended that only the subset of information which is likely to prove relevant to the treatment be forwarded to the combat zone, e.g., chronic disease, physical states, and allergies. The bulk of the record could be retained at a central triservice holding station in CONUS. The patient's history as a battle casualty must be inserted into that record. Records of discharge or death of a patient must be forwarded to the holding station from whatever echelon makes final disposition of the patient from the medical system.

To make interservice cooperation in casualty care most effective, the data systems of all services must be compatible, if not identical. Close interservice cooperation in the development of those systems is, therefore, of the highest importance.

The minimal data requirement from each echelon is listed below.

Echelon I: Corpsman or Buddy (At injury site)
The patient's name and SSAN
The patient's unit (can be filled out in advance)
The patient's treatment and time of treatment
The time and date of patient's wound.

Echelon II: Battalion Aid (First medical treatment; treatment does not include use of general anesthetics - emergency and resuscitative treatment.)
Transmitted and (where possible) verified Echelon I data
A continuous record of treatment
Any additional injury description
The treatment unit ID
A disposition record, if patient discharged.

Echelon III: Regimental Aid Station/Medical Battalion: (Capable of primary definitive care)
Verified information from Echelons I and II, transferred into a paper record (see section on methods), the Combat Casualty Record

A continuous record of treatment which serves as The Definitive Diagnosis
The identity of the causative agent of wound, if possible
A disposition record, if patient discharged.

NOTE: At Echelon III, in transit between Echelons III and IV, and between IV and V, it is essential that the patient's record remain physically attached to the patient or his litter to prevent loss of records. It is recommended that the record not be held at the nurses' station, or at any other central location.

Echelon IV: Advanced Base Functional Component (ABFC) Equivalent (Capable of subspecialty definitive care)
Transmittal and preservation of all information received from Echelon III
A continuous record of treatment
The addition of any significant ancillary data
A completed record checklist (to ensure record is complete)
A completed record, if patient is discharged
A condensed record, if patient is passed to Echelon V.

Echelon V: Reconstructive and Convalescent Care
A continuous record of treatment
The integration of the Combat Casualty Record with the patient's clinical record and health record, obtained from the triservice holding station
Coded diagnostic and treatment information for data processing
A record of disposition.

In summary, the data provided by each echelon must be: 1) readily collectable, 2) important in the patient's treatment at the next echelon, and 3) sufficient to permit reconstruction of the clinically important events in the patient's history when the record is coded for data processing at Echelon V.

HIGH PRIORITY

PROBLEM: The creation of a simple, self-explanatory format for the transmission of diagnostic/treatment data essential for initial patient care at or enroute to the next echelon. The use of diagnosis and/or checklists appears to provide maximal information with minimum (acceptable) effort.

GOALS: The required diagnosis/treatment data are those necessary for a continuum of good patient care. The ultimate requirements of a narrative summary are inappropriate in all but those circumstances arising at Echelon V or in Echelon III and IV when patients are discharged from the medical care system. Consolidation of data, however, in some circumstances (the 20-25% of patients in the seriously wounded category) enhances good patient care when transferring patients to the next level. Demands for additional data, e.g., logistical, personnel, etc., are either ignored or actively thwarted.

RESEARCH AVENUES: Develop and test sample diagrams for use with amputations, vascular, gastro-intestinal, genito-urinary tract and cardio-respiratory diagnoses/treatment.

HIGH PRIORITY

PROBLEM: Develop and test an experimental combat casualty record data structure including: a) paper forms/tag capable of accepting adhesive labels, and b) proposed implementation for machine use.

CONTRIBUTING FACTORS: Casualty medical data should be entered on the tag (currently DD 1380) at Echelon I and augmented at Echelon II by labels from medical treatment supplies. These tags, dated and timed, would become the initial portion of the paper record to be opened at Echelon III. The record should be extended by an appropriate paper form, again, capable of accepting adhesive labels as a record of treatment, until such time as machine entry is possible, usually at Echelon IV or aboard ship. Date/timed entry of nursing notes/physician progress should be entered in a separate section. Sections will be laid out to be a self-organized summary.

GOALS: Improved battle casualty medical data record.

RESEARCH AVENUES:
- Design a structured form and complementary tag which contains all required data and is easy to place in a machine form.
- Test the ease of data entry in field type conditions, physician acceptance in emergency medical care, and ease of machine entry of data from the forms.
- Demonstrate an effective machine structure for the record which is feasible for use at Echelon III/IV as an operational system.

HIGH PRIORITY

PROBLEM: Development of a miniaturized adhesive label that would be affixed to individual medical supplies. The label should include Federal Item Identification Number and nomenclature, and be graphically coded to facilitate visual and machine recognition. It must permit ease in physical transferability to a combat casualty tag/record. The label must withstand environmental conditions when so attached, and could be texturized or color symbolized.

CONTRIBUTING FACTORS: Reduction of treatment coding errors and voluminous recordkeeping. Minimizes utilization of recording instruments not able to withstand environmental conditions or their non-availability.

GOALS: Would serve as a record of initial medical treatment that could be subsequently machine scanned for logistic inventory control and accounting.

RESEARCH AVENUES: Requirement for more basic science knowledge and investigation.

HIGH PRIORITY

PROBLEM: Intermittent need for study of specialized conditions, wounds, and treatment modalities, under combat conditions.

CONTRIBUTING FACTORS: The physician and other care providers in a combat care situation cannot be expected to collect research data of a specialized nature relating to the effects of weapons, treatment modalities, or disease conditions, particularly those developed as ad hoc protocols during the conflict.

GOALS: The study of weapons effect, e.g., wounds caused by M-26 grenades, the efficacy of bypass grafts in limb survival, the efficacy of the protective helmet in protection against missiles, the selection of proper fluid therapy, and the use of diagnostic tests are all examples of appropriate studies.

RESEARCH AVENUES: The formation of multidisciplinary triservice teams to develop in peacetime the appropriate protocols to be utilized by special teams of health care professionals dedicated to that protocol in a combat situation. The composition of teams and the identification of personnel are appropriate ongoing activities during peacetime. The sending of teams to study these problems in any available conflict in which U.S. forces are not engaged, i.e., Middle East, Angola, would provide preliminary information which could aid in refining protocols or study areas.

MEDIUM PRIORITY

PROBLEM: The existing proposed clinical information systems do not and should not provide administrative management and planning information. This lack seriously hampers necessary administrative functions for short and long term control of the system.

CONTRIBUTING FACTORS: Recent emphasis by DOD and OMB on contingency requirements has made such data critical to future size and composition of the services' medical departments. In increasingly intense, short and diverse combat situations the operational medical commander needs timely information about the location, saturation and reserve of his medical forces, which may well be inadequate for surges in casualties.

GOALS: The creation of a simple but complete administrative information system which does not compete with, or rely on, the clinical information system. The system should yield, at a minimum, the following information:

Battle casualty rates, daily
Disease and non-battle injury (DNBI) rates, daily
Non-effective patient days
Medical capacity in country, daily
Workload/facility, daily
Average daily patient load (ADPL) as a percent of bed capacity
Length of patient stay (LOPS) for patients admitted/evacuated for each facility
Major and minor surgical procedures and performing specialty
Medical intelligence of anticipated combat levels
Evacuation capacity available intra and intercountry
Discharge/evacuation disposition of each patient by treating clinical specialty

RESEARCH AVENUES: No specific research is required. This subject could be addressed by the Triservice Medical Information System (TRIMIS) and the Medical Resource Management Committee with line participation as they deem appropriate.

MEDIUM PRIORITY

PROBLEM: The present "dog tag" is of questionable value in combat casualty care due to insufficient data content, and its metallic composition.

CONTRIBUTING FACTORS: The tag's composition causes individuals in combat to leave them behind because noise from the tag betrays the wearer's position to the enemy. Their value for identification is thus lost.

GOALS: A silent tag should be developed which would aid identification and contain more pertinent medical data which might be critical for survival in combat situations. Data required, but not limited to: allergies (color coded or human readable letter), dosimeter which could record radiation exposure, and any chronic disease or physical anomalies. These tags should also be integrated with the medical care treatment card project so that the data on one are compatible with the data on the other.

RESEARCH AVENUES:
- Develop and test a fire retardant, noiseless dog tag.
- Investigate the possibility of inclusion of a radiation sensitive material which would give a quantitative indicator of radiation exposure.
- Devise a mechanism for placing relevant medical data into the tag, so it can be readily read by medical treatment personnel.

MEDIUM PRIORITY

PROBLEM: No mechanism to feed back information from hospitals to primary care echelons is available. At least two forms of desirable information are identified: 1) further clinical course of specific patients as requested by

primary care physician, and 2) observations of complications in recovery of patients.

CONTRIBUTING FACTORS: There is no organized method for feeding back patient data, or for locating a patient in the system. A physician should be able to locate a patient he has treated and obtain any follow-up information necessary to assess the effectiveness of his treatment. Additionally, primary care physicians have no way of knowing if their treatment protocols are causing or contributing to complications. With the present system, there is no provision to feed back information concerning efficacy of treatment. Any such information is acquired as a result of personal interest and effort.

GOALS: A medical record system with continuity across medical echelons with treatment efficacy feed back to provide accurate and timely information to the primary care physician.

RESEARCH AVENUES: Operations analysis, systems engineering, combat casualty management.

Miscellaneous Problems and Recommendations

MISCELLANEOUS PROBLEMS AND RECOMMENDATIONS

During the course of the workshop a number of problem areas were identified which have significant impact on the management and care of combat casualties. While the solutions to these problems do not fall specifically within the mission of the Naval Medical Research and Development Command, they were considered of sufficient importance to be included in this report. These problem areas primarily concern personnel training requirements and medical support capabilities afloat. The submitted comments and recommendations follow.

HIGH PRIORITY

PROBLEM: Dedicated medical support afloat. There is a need for a dedicated medical support ship to provide optimal patient care during amphibious operations. Employment in the objective area could range from a few days, i.e., during the amphibious assault phase, to an undetermined length of time if total support is to be provided from a seabased mode, i.e., Seaborne Mobility Logistics (SML) concept. The need for quality care shortly after injury is recognized as the major deterrent to morbidity and mortality. Factors which require a dedicated medical support ship are:

Need for an optimal mix of medical and paramedical specialists.

Need for sophisticated equipment designed and integrated into a dedicated medical support platform.

Need for a large medical holding capability aboard medical support platform.

A dedicated medical support ship would automatically be kept abreast of ever-changing technology both in equipment and treatment techniques.

GOALS: Design and construct a ship dedicated only to medical treatment/care.

RECOMMENDATIONS: Development of design criteria for design of a new ship, use of modular components, or a roll-on, roll-off ship to provide a dedicated platform for medical support.

HIGH PRIORITY

PROBLEM: There is a requirement for continuing medical education during peacetime of combat casualty care to assure that lessons learned do not have to be relearned under combat conditions. This should include areas of preventive medicine, environmental medicine and mass casualty/trauma management.

RECOMMENDATIONS:

- Develop continuing education and training systems to disseminate previous war experience to physicians currently on active duty.
- Update NATO Handbook of Emergency War Surgery every five years and distribute to all military surgeons.
- Establish research centers with individual expertise to study various problem areas in the care of the combat casualty. These centers will provide continuity for the study of combat casualty care during peacetime as well as maintain current interest in combat injuries.
- Establish an indoctrination program to provide information to prospective medical officers assigned to surgical teams, medical battalions, augmentation teams, etc. What to expect in regard to what equipment and supplies they will have, what is the position in the organization/command structure, etc. Included in this program would be types of injuries expected, and proper methods of treatment.
- Initial personnel assignments to war zones should include surgeons with previous war surgery experience to train the inexperienced surgeon in methods of treatment.
- Provide periodic review and updating sessions to continue interest in the combat casualty program.
- Organize a program for active duty and reserve surgical team(s) to joint forces, and be sent to the scene of a mass casualty/natural disaster/combat, foreign or domestic.

In addition, participants viewed with concern the apparent degradation of the quality of corpsmen being turned out of the basic hospital corps "A" school. The current course length of only nine weeks cannot possibly produce the same quality and product that resulted from former courses ranging up to 22 weeks in duration. This shortened course was not initiated by the Bureau of Medicine and Surgery, but directed by higher authority. There may not be any possibility of increasing course length, due to budgetary and other constraints, but perhaps some formal feedback on observed/perceived corpsman training deficiencies to Naval Health Sciences Education Training Command curriculum advisors would be of benefit.

Summary Remarks

SUMMARY REMARKS

ADMIRAL LANING: Last night I had difficulty falling asleep, picked up the Gideon Bible next to my bed, and started reading the last chapter on the Revelations. I decided that the description of the end of the world is not yet here. Therefore, this workshop is justified, and worthwhile. Many good ideas have been presented here. Most of the results of what comes out of this will be used by personnel who are directing facilities in Code 5. I thank you for including me and hope that it does not end here. If any of you have more ideas, send them in.

COLONEL WHITE: I would like to thank you for allowing me to sit in, because I find this is an area that has been discussed for the last several months within the R&D community. It is very refreshing to have a chance to hear some of the individuals who are the customers and users in these problem areas, and to listen to their viewpoints.

We have made a great step forward. A few years ago, when Captain Brodine and I first sat down and talked about this subject, the only thing we could agree in common was that this was an area that nobody really wanted to talk about. At least we are talking about it; this is a great step forward.

I would like to remind you of something that a very learned line officer, that I respect, said: "We can do unlimited R&D, but just remember one thing, we always fight a war with the technology we have on hand. You do not invent and build new things during wartime. Peacetime is a unique period when everybody wants to avoid spending optional money. But, that is the time when you should be getting your technology base in form and in shape, ready to go into the next war."

My concern in this area has been the fact that we are spending roughly $130 M a year in what we, in DOD, call medical and life sciences. If I include environmental quality, an increasing area, and some of the CB defense that has been discussed here, I would add another $50 M. Therefore, the total is between $130 M and $180 M.

That sounds like a gigantic amount of money. Fifty percent of it is spent on items such as developing new ejection seats, establishing design criteria,

new diving standards, and toxicology standards, etc. There are no problems at all trying to defend the need for money in these areas. Another 25% is spent on infectious diseases. This is an area, if you look back historically, that was being starved to death between Korea and Vietnam, until we got into something called drug resistant malaria. Suddenly, the line, the operational people, became greatly concerned.

All other medical and life sciences receive the remaining 25 percent. Included in that 25% is what I have always considered the reason for existence of military medical departments: taking care of casualties. Many of these are disease casualties as well as combat casualties. But, it struck me, as I reviewed the program, that there must be something wrong if we are able to justify spending only that small percentage of total funds in doing, what I consider, one of our primary jobs.

I then began to probe the Army, Navy and Air Force, and found that there were numerous things that we did not know. Furthermore, I found that corporate memories were leaving the service. As a result, we are going to have the opportunity to relearn for the fourth time, starting from zero, all the lessons that we learned in the past, when we get into a conflict.

If I am to stimulate enough unrest in the services and in the Assistant Secretary of Defense for Health and Environment we, perhaps, should document requirements in a manner similar to that done when we need a new ejection seat or diving gear. If we could establish this documentation for casualty care requirements, we shall be able to obtain additional funds.

I agree with Admiral Custis. This is a difficult time to be trying to raise new money. But, in the two years that I have been in DOD at the DDR&E level, I have never been turned down, if the operational requirements were sufficiently justified.

I do want to say, publicly, to Captain Brodine and to the folks in the Navy, that I take my hat off to you. You stepped out smartly, and have done a tremendous job in documenting the requirements for combat casualty care. With good documentation, I have a reasonable chance of being able to support a set of R&D requirements. I probably shall not be able to do everything, but, at least, I think we can get it under way.

I am hoping that this report will be more than a Navy report. It was very pleasing to see the representation of the three services here; actually, four services since there are so many who are working with the Marines.

I anticipate, also, that some of these ideas about burn units, infectious disease treatment units, neurosurgery units, etc., must be needed in the Army and Air Force as well as the Navy. I would like to see the services put these units together. This is an important requirement. I would like to propose that R&D

offers the opportunity to get the data, and to get the hardware, and to test new and existing concepts of combat casualty care, if they bear being tested.

CAPTAIN BRODINE: In my opening remarks, I indicated that there were three ingredients for this meeting, the preplanning and agenda, the environment that the meeting has taken place in, and the most important ingredient - the participants. I said if you functioned in a very effective fashion that this would be a successful workshop. Indeed, it has been just that.

There have been some brief comments as to how the report from this workshop will be used. As Colonel White alluded, the problems that we have been addressing during the past three days, have, in part, been slanted toward Navy and Marine Corps support. Virtually everyone of these problems have a commonality for the Army and the Air Force. The value of this meeting will be important not only to the Navy, but to the Army and the Air Force as well. We do plan, after we get the final report, to coordinate our approach on these requirements with appropriate individuals in both the Army and the Air Force.

In this line, in approximately one-year time, we shall be sending out a newsletter to all the individuals who have attended and participated in this workshop, to give a status report as to what actions have been taken, or which actions are projected to be implemented as regards to these requirements.

It is obvious to everyone, that we shall not be able to do everything. On those items where no action has or can be taken, we would like to give you our best assessment as to why this is the case.

In addition, I sense the value of this meeting will go far beyond that of the printed report. There has been a value that is hard to put a dollar sign on or any quantitative symbol as regards the communication between the various people; not just between Army, Navy and Air Force and other governmental representatives here, but within the Navy itself.

I would hope that the dialogues initiated over the past three days will continue. I would like to suggest that for, at least, one point of contact, the Naval Medical Research and Development Command would be standing ready to act as a clearing house and respond to you on any comments or ideas that you have downstream.

I would like to solicit any constructive criticism that you have in regards to the conduct of this meeting. It has been apparent to all of us that there were individuals who could have been present who would have been very helpful. This kind of comment, while it is still fresh in your mind, will be of value for future meetings of this nature. I, too, agree that this cannot be a one-time effort; we should think about having it again in five or ten years. This is a big and complex area which exists in a changing military environment. Therefore,

we need a continuing effort to keep updated on the state-of-the-art and re-define strategies as we move into the future.

Thank you all for the excellent participation. I hope that we shall see you in the not too distant future.